

**NE WRF MCC-1, &
REPLACEMENT**

**CONTRACT DOCUMENTS &
SPECIFICATIONS**

17-0028-UT

Prepared for



CLEARWATER
BRIGHT AND BEAUTIFUL • BAY TO BEACH

ISSUE FOR BID

JANUARY 2024

City of Clearwater, Florida
NE WRF MCC-1, DC1 & 2 REPLACEMENT
(17-0028-UT)

TABLE OF CONTENTS

SECTION I	ADVERTISEMENT OF BIDS & NOTICE TO CONTRACTORS
SECTION II	INSTRUCTIONS TO BIDDERS
SECTION III	GENERAL CONDITIONS
SECTION IV	TECHNICAL SPECIFICATIONS
SECTION IVa	SUPPLEMENTAL TECHNICAL SPECIFICATIONS
SECTION V	CONTRACT DOCUMENTS
	APPENDIX

Prepared in the Office of the City Engineer

Section I

INVITATION TO BID NOTICE TO CONTRACTORS

NE WRF MCC-1, DC1 & 2 Replacement

Documents and plans for Project #17-0028-UT are available at www.myclearwater.com/bid.

The work includes: Creation of a separate Electrical Room within the existing Control Building. New access door to Blower Room and modifications to existing concrete floor to address subsidence. Replacement and relocation of Mixer motor control center (MCC-1) and the switchgear distribution centers (DC-1 and DC-2). Removal of existing FRP structure. New 1200A Nema 4X Service Entrance Breaker with new Utility transformer connection. Incorporation of "Smart" MCC into existing SCADA system. A concrete block wall and footer will be replaced with a new grade beam foundation and CMU block. Equipment attached to the wall will need to be detached, temporarily supported and re-attached. Blower Room plenum area to be filled in and intake structure removed.

Pre-Bid Conference:

Feb. 22, 2024 at 10:00am

Zoom Meeting:

Meeting ID: 860 3190 5966

Passcode: 631912

Pre-qualification DEADLINE: March 13, 2024

Category: Sanitary & Storm Sewers

Pre-qualification Amount: \$2 million

Bids DUE: March 27, 2024 at 2:00pm

City of Clearwater, Project 17-2028-UT

Procurement Office, 3rd Floor

100 S. Myrtle Ave, Clearwater, FL 33756-5520

Bid Opening: March 27, 2024 at 2:00pm

Issued by Lori Vogel, CPPB, Procurement Manager

For additional information contact Public Works

Engineering Dept.: 727-562-4750

SECTION II

INSTRUCTIONS TO BIDDERS

Table of Contents

1.	COPIES OF BIDDING DOCUMENTS.....	1
2.	QUALIFICATION OF BIDDERS	1
3.	EXAMINATION OF CONTRACT DOCUMENTS AND SITE	1
4.	INTERPRETATIONS AND ADDENDA	2
5.	BID SECURITY OR BID BOND	3
6.	CONTRACT TIME	3
7.	LIQUIDATED DAMAGES	3
8.	SUBSTITUTE MATERIAL AND EQUIPMENT	3
9.	SUBCONTRACTORS.....	3
10.	BID/PROPOSAL FORM	4
11.	SUBMISSION OF BIDS	4
12.	MODIFICATION AND WITHDRAWAL OF BIDS	5
13.	REJECTION OF BIDS	5
14.	DISQUALIFICATION OF BIDDER.....	5
15.	OPENING OF BIDS.....	5
16.	LICENSES, PERMITS, ROYALTY FEES AND TAXES	5
17.	IDENTICAL TIE BIDS/VENDOR DRUG FREE WORKPLACE	6
18.	AWARD OF CONTRACT.....	7
19.	BID PROTEST.....	7
20.	TRENCH SAFETY ACT	8
21.	CONSTRUCTION SITE EROSION AND SEDIMENT CONTROL MANAGEMENT MEASURES.....	8

1. COPIES OF BIDDING DOCUMENTS

- 1.1. Complete sets of the Bidding Documents are accessible through the City of Clearwater website at address: www.myclearwater.com/bid. Bidding Documents may include, but are not limited to, plans, specifications, bond forms, contract form, affidavits, bid/proposal form, and addendums.
- 1.2. Complete sets of Bidding Documents must be used in preparing bids. Neither the City nor the Engineer shall be liable for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents, by Bidders, sub-bidders, or others.

2. QUALIFICATION OF BIDDERS

- 2.1. Each prospective Bidder must pre-qualify to demonstrate, to the complete satisfaction of the City of Clearwater, that the Bidder has the necessary facilities, equipment, ability, financial resources and experience to perform the work in a satisfactory manner. An application package for pre-qualification may be obtained by contacting the City of Clearwater, Engineering Department, P.O. Box 4748, Clearwater, Florida 33758-4748 (mailing address); 100 South Myrtle Avenue, Clearwater, Florida 33756-5520 (street address) or by phone at (727) 562-4750. Pre-qualification requirement information is also available on the City of Clearwater Website at address:

www.myclearwater.com/government/city-departments/engineering/construction-management.

Contractors wanting to pre-qualify to bid on a project as a General Contractor must do so two weeks (ten workdays) prior to the bid opening date. Bidders currently pre-qualified by the City do not have to make reapplication. It is the Contractor's responsibility to confirm pre-qualification status before a Bid Opening.

The Contractor shall provide copies of the current Contractor License/Registration with the State of Florida and Pinellas County in the bid response.

3. EXAMINATION OF CONTRACT DOCUMENTS AND SITE

- 3.1. It is the responsibility of each Bidder, before submitting a Bid, to (a) examine the Contract Documents thoroughly; (b) visit the site to become familiar with local conditions that may in any manner affect cost, progress, performance or furnishing of the work; (c) consider and abide by all applicable federal, state and local laws, ordinances, rules and regulations; and (d) study and carefully correlate Bidder's observations with the Contract Documents, and notify Engineer in writing of all conflicts, errors or discrepancies in the Contract Documents.
- 3.2. For the purposes of bidding or construction, bidder may rely upon the accuracy of the technical data contained in reports of explorations and tests of subsurface conditions at the site which have been utilized by the Engineer in the preparation of the Contract Documents, but not upon non-technical data, interpretations or opinions contained therein or for the completeness thereof. Drawings relating to physical conditions of existing surface and subsurface conditions (except Underground Facilities) which are at or contiguous to the site and which have been utilized by the Engineer in preparation of the Contract Documents, may be relied upon by Bidder for accuracy of the technical data contained in such drawings but not upon the completeness thereof for the purposes of bidding or construction.

- 3.3. Information and data reflected in the Contract Documents with respect to Underground Facilities at or contiguous to the site are based upon information and data furnished to the City and Engineer by owners of such Underground Facilities or others, and the City does not assume responsibility for the accuracy or completeness thereof unless expressly provided in the Contract Documents.
- 3.4. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders on subsurface conditions, Underground Facilities, other physical conditions, possible conditions, and possible changes in the Contract Documents due to differing conditions appear in the General Conditions.
- 3.5. Before submitting a Bid, each Bidder shall, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests and studies and obtain any additional information and data which pertain to the physical conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing the work in accordance with the time, price and other terms and conditions of the Contract Documents.
- 3.6. On request in advance, City will provide each Bidder access to the site to conduct such explorations and tests at Bidder's own expense as each Bidder deems necessary for submission of a Bid. Bidder shall fill all holes and clean up and restore the site to its former condition upon completion of such explorations and tests.
- 3.7. The lands upon which the Work is to be performed, rights-of-way and easements for access thereto and other lands designated for use by the Contractor in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by the Contractor. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by the City unless otherwise provided in the Contract Documents.
- 3.8. The submission of a Bid will constitute an unequivocal representation by the Bidder that the Bidder has complied with every requirement of these Instructions to Bidders and that, without exception, the Bid is premised upon performing and furnishing the Work required by the Contract Documents by such means, methods, techniques, sequences or procedures of construction as may be indicated in or required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions of performance and furnishing of the work.

4. INTERPRETATIONS AND ADDENDA

- 4.1. All questions as to the meaning or intent of the Contract Documents are to be directed in writing to the Engineer. Interpretations or clarifications considered necessary by the Engineer in response to such questions will be issued by Addenda, via the Jiffy Reprographics Plan Room to all parties recorded by the Plan Room as plan holders having received the Bidding Documents. Questions received after the time frame specified on the pre-bid meeting agenda, prior to the date for opening of Bids, may not be answered. Only information provided by formal written Addenda will be binding. Oral and other interpretations of clarifications will be without legal effect.
- 4.2. Addenda may also be issued to modify the Bidding Documents as deemed advisable by the City or Engineer.

5. BID SECURITY OR BID BOND

- 5.1. Each Bid must be accompanied by Bid Security made payable to the City of Clearwater in an amount equal to ten percent (10%) of the Bidder's maximum Bid price and in the form of a certified or cashier's check or a Proposal/Bid Bond (on form provided in Section V) issued by a surety meeting the requirements of the General Conditions.
- 5.2. The Bid Security of the Successful Bidder will be retained until such Bidder has executed the Agreement and furnished the required Payment and Performance bonds, whereupon the Bid Security will be returned. If the Successful Bidder fails to execute, deliver the Agreement and furnish the required Bonds within ten (10) days after the award of contract by the City Council, the City may annul the bid and the Bid Security of the Bidder will be forfeited. The Bid Security of any Bidder whom the City believes to have a reasonable chance of receiving the award may be retained by the City until the successful execution of the agreement with the successful Bidder or for a period up to ninety (90) days following bid opening. Security of other Bidders will be returned approximately fourteen (14) days after the Bid Opening.
- 5.3. The Bid Bond shall be issued in the favor of the City of Clearwater by a surety company qualified to do business in, and having a registered agent in, the State of Florida.

6. CONTRACT TIME

- 6.1. The number of consecutive calendar days within which the work is to be completed is set forth in the Technical Specifications.

7. LIQUIDATED DAMAGES

- 7.1. Provisions for liquidated damages are set forth in the Contract Agreement, Section V.

8. SUBSTITUTE MATERIAL AND EQUIPMENT

- 8.1. The contract, if awarded, will be on the basis of material and equipment described in the Drawings or specified in the Specifications without consideration of possible substitute or "or equal" items. Whenever it is indicated in the Drawings or specified in the Specifications that a substitute or "or equal" item may be furnished or used, application for its acceptance will not be considered by the Engineer until after the effective date of the Contract Agreement. The procedure for submittal of any such application is described in the General Conditions and as supplemented in the Technical Specifications.

9. SUBCONTRACTORS

- 9.1. If requested by the City or Engineer, the Successful Bidder, and any other Bidder so requested, shall, within seven (7) days after the date of the request, submit to the Engineer an experience statement with pertinent information as to similar projects and other evidence of qualification for each Subcontractor, supplier, person and organization to be used by the Contractor in the completion of the Work. The amount of subcontract work shall not exceed fifty percent (50%) of the Work except as may be specifically approved by the Engineer. If the Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, supplier, other person or organization, he may, before recommending award of the Contract to the City Council, request the Successful Bidder to submit an acceptable substitute without an increase in Contract Price or Contract Time. If the Successful Bidder declines to make any such substitution, the City may award the contract to the next lowest and most responsive Bidder

that proposes to use acceptable Subcontractors, Suppliers, and other persons and organizations. Declining to make requested substitutions will not constitute grounds for sacrificing the Bid Security to the City of any Bidder. Any Subcontractor, supplier, other person or organization listed by the Contractor and to whom the Engineer does not make written objection prior to the recommendation of award to the City Council will be deemed acceptable to the City subject to revocation of such acceptance after the Effective Date of the Contract Agreement as provided in the General Conditions.

- 9.2. No Contractor shall be required to employ any Subcontractor, supplier, person, or organization against whom he has reasonable objection.

10. BID/PROPOSAL FORM

- 10.1. The Bid/Proposal Form is included with the Contract Documents and shall be printed in ink or typewritten. All blanks on the Bid/Proposal Forms must be completed. Unit Prices shall be to no more than two decimal points in dollars and cents. The Bidder must state in the Bid/Proposal Form in words and numerals without delineation's, alterations or erasures, the price for which they will perform the work as required by the Contract Documents. Bidders are required to bid on all items in the Bid/Proposal form. The lump sum for each section or item shall be for furnishing all equipment, materials, and labor for completing the section or item as per the plans and contract specifications. Should it be found that quantities or amounts shown on the plans or in the proposal, for any part of the work, are exceeded or should they be found to be less after the actual construction of the work, the amount bid for each section or item will be increased or decreased in direct proportion to the unit prices bid for the listed individual items.
- 10.2. Bids by corporations shall be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal shall be affixed. The corporate address and state of incorporation shall be shown below the Signature. If requested, the person signing a Bid for a corporation or partnership shall produce evidence satisfactory to the City of the person's authority to bind the corporation or partnership.
- 10.3. Bids by partnerships shall be executed in the partnership name and signed by a general partner, whose title shall appear under the signature and the official address of the partnership shall be shown below the signature.
- 10.4. All names shall be typed or printed below the signature.

11. SUBMISSION OF BIDS

- 11.1. Sealed Bids shall be submitted at or before the time and at the place indicated in the Advertisement for Bids and shall be submitted in a sealed envelope with the project name and number on the bottom left hand corner. If forwarded by mail, the Bid shall be enclosed in another envelope with the notation "Bid Enclosed" on the face thereof and addressed to the City of Clearwater, attention Purchasing Manager. Bids will be received at the office indicated in the Advertisement until the time and date specified. Bids in any other form will not be accepted.
- 11.2. The sealed bid envelope shall contain, but not be limited to, the Proposal/Bid Bond and corresponding Power of Attorney, Affidavit, Non-Collusion Affidavit, Proposal (pages one

and two), Addendum Sheet, Bidder's Proposal, ~~and~~ Scrutinized Companies and Business Operations with Cuba and Syria Certification Form, and E-Verify form.

12. MODIFICATION AND WITHDRAWAL OF BIDS

- 12.1. Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered as described in the Advertisement of Bids. A request for withdrawal or a modification shall be in writing and signed by a person duly authorized to do so. Withdrawal of a Bid will not prejudice the rights of a Bidder to submit a new Bid prior to the Bid Date and Time. After expiration of the period for receiving Bids, no Bid may be withdrawn or modified.
- 12.2. After a bid is received by the City, the bidder may request to modify the bid for typographical or scrivener's errors only. The bidder must state in writing to the City that a typographical or scrivener's error has been made by the bidder, the nature of the error, the requested correction of the error, and what the adjusted bid amount will be if the correction is accepted by the City. The City reserves the right at its sole discretion to accept, reject, or modify any bid.

13. REJECTION OF BIDS

- 13.1. To the extent permitted by applicable State and Federal laws and regulations, the City reserves the right to reject any, and all Bids, and to waive any, and all informalities. Grounds for the rejection of a bid include but are not limited to a material omission, unauthorized alteration of form, unauthorized alternate bids, incomplete or unbalanced unit prices, or irregularities of any kind. Also, the City reserves the right to reject any Bid if the City believes that it would not be in the best interest of the public to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by the City. The City reserves the right to decide which bid is deemed to be the lowest and best in the interest of the public.

14. DISQUALIFICATION OF BIDDER

- 14.1. Any or all bids will be rejected if there is any reason for believing that collusion exists among the bidders, the participants in such collusion will not be considered in future proposals for the same work. Each bidder shall execute the Non-Collusion Affidavit contained in the Contract Documents.

15. OPENING OF BIDS

- 15.1. Bids will be opened and read publicly at the location and time stated in the Advertisement for Bids. Bidders are invited to be present at the opening of bids.

16. LICENSES, PERMITS, ROYALTY FEES AND TAXES

- 16.1. The Contractor shall secure all licenses and permits (and shall pay all permit fees) except as specifically stated otherwise in the Technical Specifications. The Contractor shall comply with all Federal and State Laws, County and Municipal Ordinances and regulations, which in any manner effect the prosecution of the work. City of Clearwater building permit fees and impact fees will be waived except as specifically stated otherwise in the Technical Specifications.

- 16.2. The Contractor shall assume all liability for the payment of royalty fees due to the use of any construction or operation process, which is protected by patent rights except as specifically stated otherwise in the Technical Specifications. The amount of royalty fee, if any, shall be stated by the Contractor.
- 16.3. The Contractor shall pay all applicable sales, consumer, use, and other taxes required by law. The Contractor is responsible for reviewing the pertinent State Statutes involving the sales tax and sales tax exemptions and complying with all requirements.
- 16.4. The City of Clearwater is exempt from state sales tax on materials purchased by the City and incorporated into the WORK. The City of Clearwater reserves the right to implement the Owner Direct Purchase (ODP) Option, as may be indicated in the Scope of Work Description in Section IV – Technical Specifications and as defined in Section III – General Conditions.

17. IDENTICAL TIE BIDS/VENDOR DRUG FREE WORKPLACE

- 17.1. In accordance with the requirements of Section 287.087 Florida Statutes regarding a Vendor Drug Free Workplace, in the event of identical tie bids, preference shall be given to bidders with drug-free workplace programs. Whenever two or more bids which are equal with respect to price, quality, and service are received by the City for the procurement of commodities or contractual services, a bid received from a business that certifies that it has implemented a drug-free workplace program shall be given preference in the award process. Established procedures for processing tie bids will be followed if none or all of the tied bidders have a drug-free workplace program. In order to have a drug-free workplace program, a contractor shall supply the City with a certificate containing the following six statements and the accompanying certification statement:
- (1) Publish a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the workplace and specifying the actions that will be taken against employees for violations of such prohibition.
 - (2) Inform employees as to the dangers of drug abuse in the workplace, the business's policy of maintaining a drug-free workplace, any available drug counseling, rehabilitation, and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violations.
 - (3) Give each employee engaged in providing the commodities or contractual services that are under bid a copy of the statement specified in subsection (1).
 - (4) In the statement specified in subsection (1), notify the employees that, as a condition of working on the commodities or contractual services that are under bid, the employee will abide by the terms of the statement and will notify the employer of any conviction of, or plea of guilty or nolo contendere to, any violation of chapter 893, or of any controlled substance law, of the United States, or of any state, for a violation occurring in the workplace no later than five (5) days after such conviction.
 - (5) Impose a sanction on or require the satisfactory participation in a drug abuse assistance or rehabilitation program if such is available in the employee's community, by any employee who is so convicted.
 - (6) Make a good faith effort to continue to maintain a drug-free workplace through implementation of this section.

I certify that this firm does/does not (select only one) fully comply with the above requirements.

18. AWARD OF CONTRACT

- 18.1. Discrepancies between words and figures will be resolved in favor of words. Discrepancies in the multiplication of units of work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.
- 18.2. In evaluating the Bids, the City will consider the qualifications of the Bidders, whether the Bids comply or not with the prescribed requirements, unit prices, and other data as may be requested in the Bid/Proposal form. The City may consider the qualifications and experience of Subcontractors, suppliers and other persons and organizations proposed by the Contractor for the Work. The City may conduct such investigations as the City deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, Suppliers and other persons, and organizations to perform and furnish the Work in accordance with the Contract Documents to the City's satisfaction within the prescribed time.
- 18.3. If the Contract is to be awarded, it will be awarded to the lowest responsible, responsive Bidder whose evaluation by the City indicates to the City that the award will be in the best interest of the City.
- 18.4. Award of contract will be made for that combination of base bid and alternate bid items in the best interest of the City, however, unless otherwise specified all work awarded will be awarded to only one Contractor.
- 18.5. The successful bidder/contractor will be required to comply with Section 119.0701, Florida Statutes, specifically to:
- (a) Keep and maintain public records that ordinarily and necessarily would be required by the City of Clearwater in order to perform the service;
 - (b) Provide the public with access to public records on the same terms and conditions that the City of Clearwater would provide the records and at a cost that does not exceed the cost provided in this chapter or as otherwise provided by law;
 - (c) Ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law; and
 - (d) Meet all requirements for retaining public records and transfer, at no cost, to the City of Clearwater all public records in possession of the contractor upon termination of the contract and destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. All records stored electronically must be provided to the public agency in a format that is compatible with the information technology systems of the City of Clearwater.

19. BID PROTEST

19.1. RIGHT TO PROTEST:

Pursuant to Section 2.562(3), Clearwater Code of Ordinances, a bidder who submitted a response to a competitive solicitation and was not selected may appeal the decision through the bid protest procedures, a copy of which shall be available in the Procurement Division. A protesting bidder must include a fee of one percent of the amount of the bid or proposed contract to offset the City's additional expenses related to the protest. This fee shall not exceed

\$5,000.00 nor be less than \$50.00. Full refund will be provided should the protest be upheld. No partial refunds will be made.

20. TRENCH SAFETY ACT

- 20.1. The Bidder shall comply with the provisions of the City of Clearwater’s Ordinance related to trench digging (Ordinance No. 7918-08) along with the Florida Trench Safety Act (Sections 553.60-553.64, Florida Statutes) and the provisions of the Occupational Safety and Health Administration's (OSHA) excavation safety standards, 29 C.F.R.s 1926.650 Subparagraph P, or current revisions of these laws.

21. CONSTRUCTION SITE EROSION AND SEDIMENT CONTROL MANAGEMENT MEASURES

- 21.1. The Bidder shall comply with the provisions of the Environmental Protection Agency (EPA) National Pollution Discharge Elimination System (NPDES) stormwater permit and implement stormwater pollution prevention plans (SWPPP’s) or stormwater management programs (both using best management practices (BMPs) that effectively reduce or prevent the discharge of pollutants into receiving waters.
- A. The control of construction-related sediment loadings is critical to maintaining water quality. The implementation of proper erosion and sediment control practices during the construction stage can significantly reduce sediment loadings to surface waters.
- B. Prior to land disturbance, prepare and implement an approved erosion and sediment control plan or similar administrative document that contains erosion and sediment control provisions.

NPDES Management Measures available at [City of Clearwater Engineering Environmental Division](#) and [EPA](#) websites to help address construction-related Best Management Practices.

SECTION III

GENERAL CONDITIONS

Table of Contents:

1. DEFINITIONS	1
2. PRELIMINARY MATTERS	5
2.1. DELIVERY OF BONDS AND CERTIFICATES OF INSURANCE	5
2.2. COPIES OF DOCUMENTS	5
2.3. COMMENCEMENT OF CONTRACT TIME/NOTICE TO PROCEED, STARTING THE PROJECT	5
2.4. BEFORE STARTING CONSTRUCTION.....	5
2.5. PRECONSTRUCTION CONFERENCE	6
2.6. PROGRESS MEETINGS	6
3. CONTRACT DOCUMENTS, INTENT	6
3.1. INTENT	6
3.2. REPORTING AND RESOLVING DISCREPANCIES.....	7
4. AVAILABILITY OF LANDS, SUBSURFACE AND PHYSICAL CONDITIONS, REFERENCE POINTS	7
4.1. AVAILABILITY OF LANDS.....	7
4.2. INVESTIGATIONS AND REPORTS	7
4.3. PHYSICAL CONDITIONS, UNDERGROUND FACILITIES	8
4.4. REFERENCE POINTS.....	8
5. BONDS AND INSURANCE	9
5.1. PERFORMANCE AND PAYMENT BOND/CONTRACT BOND.....	9
5.2. INSURANCE REQUIREMENTS.....	9
5.2.1. COMMERCIAL GENERAL LIABILITY INSURANCE	9
5.2.2. COMMERCIAL AUTOMOBILE LIABILITY INSURANCE	10
5.2.3. WORKERS' COMPENSATION AND EMPLOYER'S LIABILITY INSURANCE...10	
5.2.4. PROFESSIONAL LIABILITY/MALPRACTICE/ERRORS OR OMISSIONS INSURANCE.....	10
5.2.5. CONTRACTOR'S EQUIPMENT/INLAND MARINE/PROPERTY INSURANCE ...10	
5.2.6. BUILDER'S RISK INSURANCE.....	10
5.3. OTHER INSURANCE PROVISIONS.....	10
5.4. WAIVER OF RIGHTS	11
6. CONTRACTOR'S RESPONSIBILITIES.....	12
6.1. SUPERVISION AND SUPERINTENDENCE	12
6.2. LABOR, MATERIALS AND EQUIPMENT	12
6.3. SUBSTITUTES AND "OR EQUAL" ITEMS	13
6.4. SUBCONTRACTORS, SUPPLIERS AND OTHERS.....	13
6.5. USE OF PREMISES.....	14
6.5.1. STAGING AREAS.....	15
6.5.2. RESTORATION TIME LIMITS.....	15
6.6. LICENSE AND PATENT FEES, ROYALTIES AND TAXES	15
6.7. LAWS AND REGULATIONS.....	16
6.7.1. E-VERIFY	16
6.8. PERMITS.....	16

6.9.	SAFETY AND PROTECTION.....	17
6.10.	EMERGENCIES.....	18
6.11.	DRAWINGS.....	18
6.11.1.	SHOP DRAWINGS, SAMPLES, RFIs, AND SUBMITTAL REVIEW.....	18
6.11.2.	AS-BUILT DRAWINGS.....	19
6.11.3.	CAD STANDARDS.....	21
6.11.4.	DELIVERABLES.....	23
6.12.	CONTRACTOR'S GENERAL WARRANTY AND GUARANTEE.....	23
6.13.	CONTINUING THE WORK.....	23
6.14.	INDEMNIFICATION.....	24
6.15.	CHANGES IN COMPANY CONTACT INFORMATION.....	24
6.16.	PUBLIC RECORDS.....	24
7.	OTHER WORK.....	25
7.1.	RELATED WORK AT SITE.....	25
7.2.	COORDINATION.....	26
8.	OWNER'S RESPONSIBILITY.....	26
9.	OWNER REPRESENTATIVE'S STATUS DURING CONSTRUCTION	26
9.1.	OWNER'S REPRESENTATIVE.....	26
9.2.	CLARIFICATIONS AND INTERPRETATIONS.....	27
9.3.	REJECTING OF DEFECTIVE WORK.....	27
9.4.	SHOP DRAWINGS, CHANGE ORDERS, AND PAYMENTS.....	27
9.5.	DECISIONS ON DISPUTES.....	27
9.6.	LIMITATIONS ON OWNER REPRESENTATIVE'S RESPONSIBILITIES.....	28
10.	CHANGES IN THE WORK.....	29
11.	CHANGES IN THE CONTRACT PRICE.....	29
11.1.	CHANGES IN THE CONTRACT PRICE.....	29
11.2.	ALLOWANCES AND FINAL CONTRACT PRICE ADJUSTMENT.....	31
11.3.	UNIT PRICE WORK.....	31
12.	CHANGES IN THE CONTRACT TIME.....	31
13.	TESTS AND INSPECTIONS, CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK.....	32
13.1.	TESTS AND INSPECTION.....	32
13.2.	UNCOVERING THE WORK.....	33
13.3.	OWNER'S REPRESENTATIVE MAY STOP THE WORK.....	33
13.4.	CORRECTION OR REMOVAL OF DEFECTIVE WORK.....	33
13.5.	WARRANTY/CORRECTION PERIOD.....	34
13.6.	ACCEPTANCE OF DEFECTIVE WORK.....	34
13.7.	OWNER MAY CORRECT DEFECTIVE WORK.....	34
14.	PAYMENTS TO CONTRACTOR AND COMPLETION.....	35
14.1.	APPLICATION FOR PROGRESS PAYMENT.....	35
14.2.	CONTRACTOR'S WARRANTY OF TITLE.....	36
14.3.	REVIEW OF APPLICATIONS FOR PROGRESS PAYMENTS.....	36
14.4.	PARTIAL UTILIZATION.....	37
14.5.	FINAL INSPECTION.....	37
14.6.	FINAL APPLICATION FOR PAYMENT.....	37
14.7.	FINAL PAYMENT AND ACCEPTANCE.....	38
14.8.	WAIVER OF CLAIMS.....	38

15. SUSPENSION OF WORK AND TERMINATION	39
15.1. OWNER MAY SUSPEND THE WORK.....	39
15.2. OWNER MAY TERMINATE	39
15.3. CONTRACTOR MAY STOP WORK OR TERMINATE	40
16. DISPUTE RESOLUTION.....	40
17. MISCELLANEOUS.....	41
17.1. SUBMITTAL AND DOCUMENT FORMS.....	41
17.2. GIVING NOTICE.....	41
17.3. NOTICE OF CLAIM.....	41
17.4. PROFESSIONAL FEES AND COURT COSTS INCLUDED.....	41
17.5. ASSIGNMENT OF CONTRACT	41
17.6. RENEWAL OPTION	41
17.7. ROLL-OFF CONTAINERS AND/OR DUMPSTERS	42
18. ORDER AND LOCATION OF THE WORK.....	42
19. MATERIAL USED	42
20. CONFLICT BETWEEN PLANS AND SPECIFICATIONS	42
21. OWNER DIRECT PURCHASE (ODP)	42
21.1. SALES TAX SAVINGS.....	42
21.2. TITLE AND OWNER RISK	43
21.3. CONTRACTOR’S RECEIPT OF MATERIALS.....	43
21.4. ODP RECORDS, WARRANTIES, AND INDEMNIFICATION	44
22. RESIDENT NOTIFICATION OF START OF CONSTRUCTION.....	44
22.1. GENERAL.....	44
22.2. EXAMPLE.....	45
23. PROJECT INFORMATION SIGNS	45
23.1. SCOPE AND PURPOSE.....	45
23.2. PROJECT SIGN, FIXED OR PORTABLE	46
23.3. FIXED SIGN	46
23.4. PORTABLE SIGNS	46
23.5. SIGN COLORING.....	46
23.6. SIGN PLACEMENT	46
23.7. SIGN MAINTENANCE.....	46
23.8. TYPICAL PROJECT SIGN	47
24. AWARD OF CONTRACT, WORK SCHEDULE AND GUARANTEE.	47
25. SCRUTINIZED COMPANIES AND BUSINESS OPERATIONS WITH CUBA AND SYRIA CERTIFICATION FORM AND ISRAEL CERTIFICATION FORM.....	48

1. DEFINITIONS

Addenda

Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the contract documents.

Agent

Architect, engineer or other outside agency, consultant or person acting on behalf of the City.

Agreement

The written contract between Owner and Contractor covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

Application for Payment

The form accepted by Engineer which is to be used by Contractor in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

Approve

The word approve is defined to mean satisfactory review of the material, equipment, or methods for general compliance with the design concepts and with the information given in the Contract Documents. It does not imply a responsibility on the part of the Engineer to verify in every detail conformance with the Drawings and Specifications.

Bid

The offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the work to be performed.

Bidding Documents

The advertisement or invitation to Bid, instructions to bidders, the Bid form, and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

Bonds

Performance and payment bonds and other instruments of security.

Change Order

A written order to Contractor signed by Owner and Contractor authorizing an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Time issued on or after the effective date of the Agreement.

City

The City of Clearwater, Pinellas County, Florida.

Construction Inspector

A person who is the authorized representative of the Construction Manager and inspects City construction projects in order to ensure the Contractor's work complies with the intent of the Contract Documents.

Construction Manager

The person who is typically in responsible charge of City construction projects. The Construction Manager assumes responsibility for the management of construction contracts at the Preconstruction Conference. The Construction Manager chairs the Preconstruction Conference and is the authority on any disputes or decisions regarding

contract administration and performance. The Construction Manager typically acts as the Owner's Representative during construction.

Contract Documents

The Agreement, Addenda (which pertain to the Contract Documents), Contractor's Bid (including documentation accompanying the bid and any post-Bid documentation submitted prior to the execution of the Agreement) when attached as an exhibit to the Agreement, the Bonds, Instructions to Bidders, these General Conditions, any Supplementary Conditions, the Specifications and the Drawings, any other exhibits identified in the Agreement, together with all Modifications issued after the execution of the Agreement.

Contract Price

The Contract price constitutes the total compensation (subject to authorized adjustments) payable by Owner to Contractor for performing the Work.

Contract Time

The number of days or the date stated in the Agreement for the completion of the Work.

Contractor

The Person with whom the Owner has entered into the Agreement. For the purposes of this contract, the person, firm, or corporation with whom this contract or agreement has been made by the City of Clearwater or its duly authorized representative.

Critical Path Method Construction Schedule (CPM)

A graphic format construction schedule that displays construction activities as they relate to one another for the purpose of identifying the most efficient way to perform the work in a timely manner. The critical path identifies which activity is critical to the execution of the schedule.

Day

A calendar day of twenty-four (24) hours measured from midnight to the next midnight.

Defective

An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to Engineers recommendation of final payment.

Drawings

The drawings, which will be identified in Technical Specifications or the Agreement, which show the character and scope of the Work to be performed and which have been prepared or approved by Engineer and are referred to in the contract documents. Shop drawings are not Drawings as so defined.

Engineer

The duly appointed representative of the City Manager of the City of Clearwater. For the purposes of this contract, the City Engineer of the City of Clearwater, Pinellas County, Florida, or his authorized representative. For certain projects, the Engineer may serve as the Owner's Representative during construction.

Engineer's Consultant

A Person having a contract with Engineer to furnish services as Engineer's independent

professional associate or consultant with respect to the Project and who is identified as such in the Supplementary Conditions.

F.D.O.T. Specifications

The Standard Specifications for Road and Bridge Construction as issued by the Florida Department of Transportation (latest English edition).

Furnish

The words "furnish", "furnish and install", "install", and "provide" or words of similar meaning shall be interpreted, unless otherwise specifically stated, to mean "furnish and install complete in place and ready for service".

Inspection

The term "inspection" and the act of inspecting means examination of construction to ensure that it conforms to the design concept expressed in the Drawings and Specifications. These terms shall not be construed to mean supervision, superintending, or overseeing.

Laws and Regulations

Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any kind of governmental bodies, agencies, authorities, and courts having jurisdiction.

Liens

Liens, charges, security interests or encumbrances upon real property or personal property.

Milestone

A principal event specified in the contract Documents relating to an intermediate completion date or time prior to the final completion date.

Notice to Proceed (NTP)

A written notice given by the Owner to the Contractor fixing the date on which the Contract Time will commence to run and on which Contractor shall start to perform his obligations under the Contract Documents.

Owner

The City of Clearwater, Florida. For the purposes of this contract, the person who is the City's authorized representative from the City's Department with whom will be responsible for the maintenance and operation of the Work once the Work is completed. For certain projects, a designee of the Owner may serve as the Owner's Representative during construction.

Owner's Representative

Designee of the Owner with authority to act on behalf of the Owner during construction.

Person

A natural person, or a corporation, partnership, firm, organization, or other artificial entity.

Project

The total construction of which the Work to be provided under the Contract Documents may be the whole or a part as indicated elsewhere in the Contract Documents.

Partial Utilization

Use by Owner of a substantially completed part of the Work for the purpose for which is intended (or a related purpose) prior to Final Completion of all the Work.

Representative of Contractor

The Contractor shall assign a responsible person or persons, one of whom shall be at the construction site at all times, that work is progressing. The names and positions of these persons shall be submitted to the City Engineer at the time of the pre-construction conference. This person or persons shall not be changed without written approval of City Engineer.

Request for Information (RFI)

An official written request for clarification of the intent of the contract documents from the Contractor to the Engineer.

Shop Drawing

All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for Contractor to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a supplier and submitted by Contractor to illustrate material or equipment for some portion of the Work.

Specifications

Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

Subcontractor

A person having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the site.

Substantial Completion

The Work (or a specified part thereof) which has progressed to the point where, in the opinion of Engineer, as evidenced by Engineer's definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by the Engineer's recommendation of final payment. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

Supplementary Conditions

The part of the Contract which amends or supplements these General Conditions.

Supplier

A manufacturer, fabricator, supplier, distributor, material man or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by the Contractor.

Surety

Any person, firm or corporation which is bound with Contractor and which engages to be responsible for Contractor and his acceptable performance of the Work by a Bid, Performance or Payment Bond.

Underground Facilities

All pipelines, conduits, ducts, cables, wires manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity,

gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal or treatment, traffic or other control systems or water.

Unit Price Work

Work to be paid for on the basis of unit prices.

Work

The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents.

Work Change Directive

A written directive to Contractor, issued on or after the Effective Date of the Agreement and signed by the Engineer, ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed or emergencies. Work Change Directive will not change the Contract Price or Contract Time but is evidence that the parties expect that the change directed or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

2. PRELIMINARY MATTERS

2.1. DELIVERY OF BONDS AND CERTIFICATES OF INSURANCE

When Contractor delivers the executed Agreements to the Owner, Contractor shall also deliver to the Owner such Bonds and Certificates of Insurance as Contractor may be required to furnish by this contract.

2.2. COPIES OF DOCUMENTS

Engineer shall furnish to Contractor one (1) copy of Contract Documents for execution. Additional copies will be furnished, upon request, at the cost of reproduction.

2.3. COMMENCEMENT OF CONTRACT TIME/NOTICE TO PROCEED, STARTING THE PROJECT

The Contract Time will commence on the day indicated in the Notice to Proceed. Contractor shall start to perform the work on the date the Contract Time commences to run. No work shall be done at the site prior to the date that the Contract Time commences to run. Pursuant to Section 255.05(1)(b), Florida Statutes, the Notice to Proceed cannot be issued until Contractor provides City with a certified copy of the recorded bond issued by the Pinellas County Clerk of Court.

2.4. BEFORE STARTING CONSTRUCTION

Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error or

discrepancy which Contractor may discover; and shall obtain a written interpretation or clarification from Engineer before proceeding with any work effected thereby; however, Contractor shall not be liable to the Owner for failure to report any conflict, error or discrepancy in the Drawings or Specifications, unless Contractor had actual knowledge thereof or should reasonably have known thereof.

No verbal agreement or conversation with any officer, Agent or employee of the Owner or Engineer's Consultant, either before or after the execution of this Contract, shall affect or modify any of the terms or obligations herein contained. Contractor shall not commence any work at any time without approved insurance required by these General Conditions. Failure to obtain this insurance will be the sole responsibility of the Contractor.

2.5. PRECONSTRUCTION CONFERENCE

After Contract has been fully executed and before the start of the Work, the Owner's Representative shall schedule a preconstruction conference to be attended by Contractor, Engineer, Owner and others as appropriate to establish a working understanding among the parties as to the Work and to discuss the schedule of the Work and general Contract procedures.

The Contractor shall submit to the Owner's Representative prior to the Notice to Proceed, a color Critical Path Method (CPM) Construction Schedule. This is to be a sequence of events including submittal review and procurement. Notice to Proceed is usually established at the preconstruction conference and such date can be inserted into the schedule at that time. The Contractor shall also submit a Submittal Schedule for review by the Engineer. This is to make sure that the list is complete, and this schedule shall be the basis of a Submittal Log.

The Contractor shall submit to the Owner's Representative prior to the Notice to Proceed, a completed Emergency Call List, a completed Authorized Signature List, and Verification of Illegal Discharge Construction Site Training.

2.6. PROGRESS MEETINGS

The Contractor is required to attend Progress Meetings. These meetings will be scheduled on a weekly, bi-weekly, or monthly basis depending on the needs of the project. The Contractor shall bring to each meeting an updated submittal log, an updated request for information (RFI) log, a look-ahead schedule to cover the project activity from the current meeting to the next meeting, and all material test reports generated in the same time period.

3. CONTRACT DOCUMENTS, INTENT

3.1. INTENT

The Contract Documents comprise the entire Agreement between Owner and the Contractor concerning the Work. They may be altered only by written agreement. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials or equipment which may reasonably be inferred from the Contract Documents or from prevailing custom or from trade usage as being required to produce the intended result will be furnished and performed whether or not specifically called for. When words or phrases, which have a well-known technical or construction industry or trade meaning, are used to describe Work, materials or equipment, such words or phrases shall be interpreted in accordance with that meaning. Clarifications and

interpretations of the Contract Documents shall be issued by the Owner's Representative. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or to the code, Laws or Regulation of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual or code, or Laws or Regulations in effect at the time of opening of Bids except as may be otherwise specifically stated in the Contract Documents. However, no provision of any referenced standard specification, manual or code, whether or not specially incorporated by reference in the responsibilities of Owner or Contractor as set forth in the Contract Documents, shall change the duties and responsibilities of Owner, Contractor, Engineer or Owner's Representative, or any of their Agents or employees from those set forth in the Contract Documents. Clarifications and interpretations of the Contract shall be issued by the Owner's Representative. Each and every provision of law and clause required by law to be inserted in these Contract documents shall be deemed to be inserted herein, and they shall be read and enforced as through it were included herein, and if through mistake or otherwise, any such provision is not inserted, or if not correctly inserted, then upon the application of either party, the Contract Documents shall forthwith be physically amended to make such insertion.

3.2. REPORTING AND RESOLVING DISCREPANCIES

If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity or discrepancy within the Contract Documents or between the Contract Documents and any provision of any such Law or Regulation applicable to the performance of the Work or of any such standard, specification, manual or code or of any instruction of any Supplier, Contractor shall report it to the Owner's Representative in writing at once, and Contractor shall not proceed with the Work affected thereby (except in an emergency) until an amendment or supplement to Contract Documents has been issued by one of the methods provided in these General Specifications, provided however, that Contractor shall not be liable to Owner, or Owner's Representative for failure to report any such conflict, error, ambiguity or discrepancy unless Contractor knew or reasonably should have known thereof.

4. AVAILABILITY OF LANDS, SUBSURFACE AND PHYSICAL CONDITIONS, REFERENCE POINTS

4.1. AVAILABILITY OF LANDS

The Owner shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be Performed, rights-of-way, easements, rights of entry for access thereto, and such other lands which are designated for the use of Contractor. The Owner shall identify any encumbrances or restrictions not of general application but specifically related to use of lands so furnished with which Contractor will have to comply in performing the Work. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by the Owner, unless otherwise provided in the Contract Documents.

4.2. INVESTIGATIONS AND REPORTS

Reference is made to the Supplementary Conditions and Technical Specifications for identification of those reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the Work which have been relied upon by Engineer in preparation of the Drawings and Specifications. Such reports are not guaranteed as to accuracy or completeness and are not part of the Contract Documents. Contractor shall promptly

notify the Owner's Representative in writing of any subsurface or latent physical conditions at the site, or in an existing structure, differing materially from those indicated or referred to in the Contract Documents. Engineer will promptly review those conditions and advise if further investigation or tests are necessary. Owner or Engineer shall obtain the necessary additional investigations and tests and furnish copies to the Engineer and Contractor. If Engineer finds that the results of such investigations or tests indicate that there are subsurface or latent physical conditions, which differ materially from those, indicated in the contract Documents, and which could not reasonably have been anticipated by Contractor, a work change, or Change Order will be issued incorporating the necessary revisions.

4.3. PHYSICAL CONDITIONS, UNDERGROUND FACILITIES

The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities or by others. Unless otherwise expressly provided in the Contract Documents, Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and the cost of all the following will be included in the Contract Price and Contractor shall have full responsibility for: (i) reviewing and checking all such information and data, (ii) locating all Underground Facilities shown or indicated in the Contract Documents, (iii) coordination of the Work with the owners of such Underground Facilities during construction, and (iv) the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work. The Contractor is required to call the Sunshine State One Call of Florida prior to any excavation per State regulations and to notify any utility owners who are not a member of the Sunshine State One Call of Florida prior to any excavation. The Sunshine State One Call of Florida is an agency for the protection and location of utilities prior to any excavation and contact number is available in local telephone directory.

4.4. REFERENCE POINTS

Engineer shall provide engineering surveys to establish reference points for construction, which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, unless otherwise noted in the Contract, shall protect and preserve the established reference points and shall make no changes or relocations without the prior written approval of the Owner and Engineer. Contractor shall report to Engineer whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations and shall be responsible for the accurate replacement or relocation of such reference points by a surveyor licensed in the State of Florida. The Contractor is referred to the Technical Specifications for more specific information regarding the provision of construction surveys. If a City survey crew is assigned to the project and there is excessive stake replacement caused by negligence of Contractor's forces after initial line and grade have been set, as determined by the Engineer, the Contractor will be charged at the rate of \$200.00 per hour. Time shall be computed for actual time on the project. All time shall be computed in one-hour increments with a minimum charge of one hour.

5. BONDS AND INSURANCE

5.1. PERFORMANCE AND PAYMENT BOND/CONTRACT BOND

Contractor shall furnish a Performance and Payment Bond pursuant to Section 255.05, Florida Statutes in an amount equal to the Contract Price as security for the faithful performance and payment of all Contractor's obligations under the Contract Documents. This bond shall remain in effect at least one year after the date when final payment becomes due unless a longer period of time is prescribed by laws and regulations or by the Contract Documents. Contractor shall also furnish such other Bonds as are required by the Supplementary Conditions. All Bonds shall be in the form prescribed by the Contract Documents in Section V and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff, Bureau of Government Financial Operations, U.S. Treasury Department. All bonds signed by an agent must be accompanied by a certified copy of such agents' authority to act. All bonds shall be deemed to contain all of the Conditions of Section 255.05, Florida Statutes, even if such language is not directly contained within the bond and the Surety shall be licensed and qualified to do business in the State of Florida. Owner reserves the right to reject any surety. If the Surety on any Bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of these Contract Documents, the Contractor shall within five days after notice thereof substitute another Bond and surety, both of which must be acceptable to Owner.

5.2. INSURANCE REQUIREMENTS

The Contractor shall, at its own cost and expense, acquire and maintain (and cause any Subcontractors, representatives or agents to acquire and maintain) during the term with the City, sufficient insurance to adequately protect the respective interest of the parties. Coverage shall be obtained with a carrier having an AM Best Rating of A-VII or better. In addition, the City has the right to review the Contractor's deductible or self-insured retention and to require that it be reduced or eliminated.

Specifically, the Contractor must carry the following minimum types and amounts of insurance on an occurrence basis or in the case of coverage that cannot be obtained on an occurrence basis, then coverage can be obtained on a claims-made basis with a minimum four (4) year tail following the termination or expiration of this Agreement:

The following insurance limits may be achieved by a combination of primary and umbrella/excess liability policies.

5.2.1. COMMERCIAL GENERAL LIABILITY INSURANCE

Commercial General Liability Insurance coverage, including but not limited to, premises operations, products/completed operations, products liability, contractual liability, advertising injury, personal injury, death, and property damage in the minimum amount of \$1,000,000 (one million dollars) per occurrence and \$2,000,000 (two million dollars) general aggregate.

5.2.2. COMMERCIAL AUTOMOBILE LIABILITY INSURANCE

Commercial Automobile Liability Insurance coverage for any owned, non-owned, hired or borrowed automobile is required in the minimum amount of \$1,000,000 (one million dollars) combined single limit.

5.2.3. WORKERS' COMPENSATION AND EMPLOYER'S LIABILITY INSURANCE

Statutory Workers' Compensation Insurance coverage in accordance with the laws of the State of Florida, and Employer's Liability Insurance in the minimum amount of \$100,000 (one hundred thousand dollars) each employee each accident, \$100,000 (one hundred thousand dollars) each employee by disease and \$500,000 (five hundred thousand dollars) aggregate by disease with benefits afforded under the laws of the State of Florida. Coverage should include Voluntary Compensation, Jones Act, and U.S. Longshoremen's and Harbor Worker's Act coverage where applicable. Coverage must be applicable to Employees, Contractors, Subcontractors, and Volunteers, if any.

5.2.4. PROFESSIONAL LIABILITY/MALPRACTICE/ERRORS OR OMISSIONS INSURANCE

Professional Liability/Malpractice/Errors or Omissions Insurance coverage appropriate for the type of business engaged in by the Contractor with minimum limits of \$1,000,000 (one million dollars) per occurrence. If a claims-made form of coverage is provided, the retroactive date of coverage shall be no later than the inception date of claims-made coverage, unless prior policy was extended indefinitely to cover prior acts. Coverage shall be extended beyond the policy year either by a supplemental extended reporting period (ERP) of as great a duration as available, and with no less coverage and with reinstated aggregate limits, or by requiring that any new policy provide a retroactive date no later than the inception date of claims-made coverage.

5.2.5. CONTRACTOR'S EQUIPMENT/INLAND MARINE/PROPERTY INSURANCE

If Contractor is using its own property in connection with the performance of its obligations under this Agreement, then Contractor's Equipment-Inland Marine Insurance and/or Property Insurance on an "All Risks" basis with replacement cost coverage for property and equipment in the care, custody and control of others is recommended. City is not responsible for Contractor's (or any Subcontractors, Representatives, or Agents) equipment or property.

5.2.6. BUILDER'S RISK INSURANCE

The City will provide at its expense, Builder's Risk Insurance for the project to cover all risks of loss in the complete and full value of the project. Contractor agrees to cooperate in a timely manner with providing any information or documentation required for the application and by the carrier as the project proceeds.

5.3. OTHER INSURANCE PROVISIONS

Upon approval of this Agreement by City Council, and then annually upon the anniversary date(s) of the insurance policy's renewal date(s) for as long as this Agreement remains in effect, the Contractor will furnish the City with a Certificate of Insurance(s) (using appropriate ACORD certificate, SIGNED by the Issuer, and with applicable endorsements) evidencing all of the

coverage set forth above and naming the City as an “Additional Insured.” In addition, when requested in writing from the City, Contractor will provide the City with certified copies of all applicable policies. The address where such certificates and certified policies shall be sent or delivered is as follows:

Attn: Contract and Procurement Specialist
 City of Clearwater
 Engineering Department
 P.O. Box 4748
 Clearwater, FL 33758-4748

1. The **Description** (of Operations/Locations/Vehicles) should specify Project Name and Project Number.
2. Contractor shall provide thirty (30) days written notice of any cancellation, non-renewal, termination, material change or reduction in coverage.
3. Contractor’s insurance as outlined above shall be primary and non-contributory coverage for Contractor’s negligence.
4. Contractor reserves the right to appoint legal counsel to provide for the Contractor’s defense, for any and all claims that may arise related to Agreement, work performed under this Agreement, or to Contractor’s design, equipment, or service. Contractor agrees that the City shall not be liable to reimburse Contractor for any legal fees or costs as a result of Contractor providing its defense as contemplated herein.

The stipulated limits of coverage above shall not be construed as a limitation of any potential liability to the City, and the City’s failure to request evidence of this insurance shall not be construed as a waiver of Contractor’s (or Subcontractors, Representatives, or Agents) obligation to provide the insurance coverage specified.

5.4. WAIVER OF RIGHTS

The Owner and Contractor intend that all policies purchased in accordance with Article on Insurance will protect the Owner, Contractor, Subcontractors, Engineer, Engineer's Consultants and all other persons or entities identified in the Supplementary Conditions to be listed as insured or additional insured in such policies and will provide primary coverage for all losses and damages caused by the perils covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insured or additional insured thereunder, the Owner and Contractor waive all rights against each other and their respective officers, directors, employees and agents for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the work; and, in addition, waive all such rights against Subcontractors, Engineer, Engineer's Consultants and all other persons or entities identified in the Supplementary Conditions to be listed as insured or additional insured under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance otherwise payable under any policy so issued. In addition, the Owner waives all rights against Contractor, Subcontractors, Engineer, Engineer's Consultant and the officers, directors, employees and agents of any of them for: (i) loss due to business interruption, loss of use or other consequential loss extending beyond direct physical loss or damage to the Owner property or the Work caused by, arising out of or resulting from fire or other peril, whether or not insured by the Owner and; (ii) loss or damage to the completed Project or part thereof caused by, arising out of or resulting from fire or other insured peril covered by any property insurance maintained on the completed Project or part thereof by the Owner during partial utilization, after substantial completion or after final payment.

6. CONTRACTOR'S RESPONSIBILITIES

6.1. SUPERVISION AND SUPERINTENDENCE

Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of others in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

Contractor shall be responsible to see that the completed work complies accurately with the Contract Documents. Contractor shall keep on the work at all times during its progress a competent resident superintendent, who shall not be replaced without notice to the Owner's Representative except under extraordinary circumstances. The superintendent will be Contractor's representative at the site and shall have authority to act on behalf of Contractor. All communications to the superintendent shall be as binding as if given to Contractor. The Contractor's superintendent shall keep a mobile cell phone on his person, so he can be contacted whenever necessary.

Contractor shall employ only competent persons to do the work and whenever the Owner's Representative shall notify Contractor, in writing, that any person on the work appears to be incompetent, unfaithful, disorderly, disrespectful or otherwise unsatisfactory, such person shall be removed from the project and shall not again be employed on it except with the written consent of the Owner's Representative. Contractor represents the City of Clearwater and shall conduct themselves in a professional manner to the public at all times.

Contractor shall reimburse Owner for additional engineering and inspection costs incurred as a result of overtime work in excess of the regular working hours or on the Owner normally approved holidays. At such times when Inspector overtime is required, the Contractor shall sign an overtime slip documenting such hours and the Contractor shall be provided a copy for his records. At the end of the project and prior to payment of withheld retainage funds, the Contractor shall deliver to the Owner a check made out to the Owner of Clearwater for full reimbursement of all Inspector overtime hours. Withheld retainage shall not be released until the Owner has received this check. Minimum number of chargeable hours for inspection costs on weekends or holidays shall be four hours. The cost of overtime inspection per hour shall be \$80.00 per hour.

Contractor shall provide and maintain in a neat and sanitary condition, such sanitary accommodations for the use of Contractor's employees as may be necessary to comply with the requirements of Laws and Regulations and the Engineer.

6.2. LABOR, MATERIALS AND EQUIPMENT

Contractor shall provide competent, suitably qualified personnel to survey, lay out and construct the work as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the site. Except as otherwise required for the safety or protection of persons or the work or property at the site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all work at the site shall be performed during regular working hours. Contractor shall adhere to the Community Development Code, Section 3-1508 regarding noise restrictions from 6:00 p.m. to 7:00 a.m. any day and all-day Sunday. Contractor will not permit overtime work or the performance of work on Saturday, Sunday, or any legal holiday without Owner consent given after prior notice to Engineer.

Unless otherwise specified in the General Requirements, Contractor shall furnish and assume full responsibility for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up and completion of the Work.

All materials and equipment installed in the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the quality of materials and equipment. The Contractor shall provide suitable and secure storage for all materials to be used in the Work so that their quality shall not be impaired or injured. Materials that are improperly stored, may be rejected by the Engineer without testing.

All materials and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with the instructions of the applicable manufacturer, fabricator, supplier, or distributor, except as otherwise provided in the Contract Documents.

The City of Clearwater, at its sole discretion, reserves the right to purchase major equipment or materials to be incorporated into the Work under the Owner Direct Purchase (ODP) Option, per Section III, Article 21. In such event, the Contractor shall cooperate and assist the Owner of Clearwater, at no additional cost, to implement the ODP documents and procedures.

6.3. SUBSTITUTES AND "OR EQUAL" ITEMS

Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent or "or equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be accepted by Engineer. If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer for approval. If in the Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or equal" item, it may be considered as a proposed substitute item. Contractor shall submit sufficient information as required by the Engineer to allow the Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and is an acceptable substitute, therefore. Request for review of proposed substitute and "or equal" will not be accepted by Engineer from anyone other than Contractor.

Request for substitute and "or equal" items by Contractor must be submitted in writing to Owner's Representative and will contain all information as Engineer deems necessary to make a determination. Request for substitute shall identify why a substitute is submitted and include advantages to the Owner. All data provided by Contractor in support of any proposed substitute or "or equal" item will be at Contractor's expense. Engineer will be allowed a reasonable time to evaluate each proposal or submittal made per this paragraph. Engineer will be sole judge of acceptability.

6.4. SUBCONTRACTORS, SUPPLIERS AND OTHERS

The Contractor shall deliver to the Owner's Representative before or at the preconstruction conference a list of all Subcontractors, suppliers and other persons and organizations proposed by the Contractor for Work to be performed on the Project. The Contractor shall include with this list

the qualifications and references for each Subcontractor, supplier or other person and organization for review and approval. Any changes to this list must be submitted to the Owner's Representative for approval prior to the substitution of any Subcontractors, suppliers or other persons and organizations before performing any Work on the Project for the Contractor.

Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers and other persons performing or furnishing any of the work under a direct or indirect contract with Contractor just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier or other person any contractual relationship between Owner or Engineer and any Subcontractor, Supplier or other person, nor shall it create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier or other person. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers and other persons performing or furnishing any of the work under a direct or indirect contract with Contractor. Contractor shall require all Subcontractors, Suppliers and such other persons performing or furnishing any of the work to communicate with the Engineer through Contractor.

The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the work among Subcontractors or Suppliers or delineating the work to be performed by any specific trade.

All work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.

Contractor shall not pay or employ any Subcontractor, Supplier or other person or organization whether initially or as a substitute, against whom Owner or Engineer may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier or other person or organization to furnish or perform any of the work against whom Contractor has reasonable objection.

Owner or Engineer will not undertake to settle any differences between Contractor and his Subcontractors or between Subcontractors.

6.5. USE OF PREMISES

Contractor shall confine construction equipment, the storage of materials and equipment and the operations of works to the site and land areas identified in and permitted by the Contract Documents on other land areas permitted by Laws and Regulations, right-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any adjacent land or areas, resulting from the performance of the Work. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceed in or at law. Contractor shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner, Engineer, Engineer's Consultant and their officials, directors, employees and agents from and against all claims, costs, losses and damages arising out of or resulting from any claim or action, legal or equitable, brought by any such owner or occupant against Owner,

Engineer or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

During the progress of the Work, Contractor shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work or at intervals established by the Engineer, Contractor shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery and surplus materials. Contractor shall restore to original condition all property not designated for alteration by the Contract Documents.

6.5.1. STAGING AREAS

The Contractor shall obtain and deliver to the City written permission for the use of all staging and storage areas outside of the Limits of Construction. Use of right of way within the limits of construction must be approved by the City. All applicable erosion control, tree barricade and restoration, including time limits, specifications, etc., must be followed. Contractor must provide portable restroom that is lockable for the safety of the Contractor and the surrounding residents.

6.5.2. RESTORATION TIME LIMITS

The timely restoration of all impacted areas, especially in the Right-of-Ways, is very important to the Citizens of Clearwater therefore, these time limits are imposed:

- Debris piles shall be removed within five (5) consecutive calendar days.
- Concrete driveways and sidewalks shall be replaced within ten (10) consecutive calendar days of removal. Resident access shall be maintained at all times.
- All arterial and collector roadways shall be restored ASAP.
- Local streets and asphalt driveways shall be restored as soon as a sufficient quantity is generated, however, this is never to exceed fifteen (15) consecutive calendar days. Local and resident access shall be maintained at all times.
- Any irrigation systems or components damaged or impacted by construction activities shall be repaired or replaced “in-kind” within forty-eight (48) hours to minimize the loss of turfgrass or landscape plantings, particularly during periods of drought.
- Sod must be restored “in-kind” within fourteen (14) consecutive calendar days of a successful pipe pressure test, removal of concrete forms, backfill of excavations, replacement of driveways or sidewalks or another project specific milestone. It must be watered for a period of thirty (30) days after it is placed. Erosion control and dust control of denuded areas must be maintained at all times.

If the project or a portion of it does not involve right-of ways, then a different schedule of sod restoration may be considered.

6.6. LICENSE AND PATENT FEES, ROYALTIES AND TAXES

Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the work and if to the actual knowledge of Owner or Engineer its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner or Engineer in the Contract Documents.

To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner, Engineer, Engineer's Consultants and the officers, directors, employees, agents and other consultants of each and any of them from and against all claims, costs, losses and damages arising out of or resulting from any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not specified in the Contract Documents, and shall defend all such claims in connection with any alleged infringement of such rights.

Contractor shall pay all sales, consumer, use, and other taxes required to be paid by Contractor in accordance with the Laws and Regulations of the State of Florida and other governmental agencies, which are applicable during the performance of the work.

6.7. LAWS AND REGULATIONS

Contractor shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Owner's Representative shall be responsible for monitoring Contractor's compliance with any Laws or Regulations. If Contractor performs any work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses and damages caused by or arising out of such work: however, it shall not be Contractor's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations to the Owner to report and resolve discrepancies as described above.

6.7.1. E-VERIFY

Contractor and its Subcontractors shall register with and use the E-Verify system to verify the work authorization status of all newly hired employees. Contractor will not enter into a contract with any Subcontractor unless each party to the contract registers with and uses the E-Verify system. Subcontractor must provide Contractor with an affidavit stating that Subcontractor does not employ, contract with, or subcontract with an unauthorized alien. Contractor shall maintain a copy of such affidavit.

The City may terminate this Contract on the good faith belief that Contractor or its Subcontractors knowingly violated Florida Statutes 448.09(1) or 448.095(2)(c). If this Contract is terminated pursuant to Florida Statute 448.095(2)(c), Contractor may not be awarded a public contract for at least 1 year after the date of which this Contract was terminated. Contractor is liable for any additional costs incurred by the City as a result of the termination of this Contract.

See Section 448.095, Florida Statutes (2020).

See "VERIFICATION OF EMPLOYMENT ELIGIBILITY FORM" in Appendix.

6.8. PERMITS

Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. The Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids. Contractor shall pay all charges of utility owners for connections to the work, and the Owner shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

Unless otherwise stated in the Contract Documents, Clearwater Building Permit Fees will be waived.

6.9. SAFETY AND PROTECTION

Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to: (i) all persons on the work site or who may be affected by the work, (ii) all the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and (iii) other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Facilities not designated for removal, relocation or replacement in the course of construction. In the event of temporary suspension of the work, or during inclement weather, or whenever Owner's Representative may direct; Contractor shall, and shall cause Subcontractors, to carefully protect the Work and materials against damage or injury from the weather. If, in the opinion of the Owner's Representative, any portion of Work or materials shall have been damaged or injured by reason of failure on the part of the Contractor or any Subcontractors to so protect the Work, such Work and materials shall be removed and replaced at the expense of Contractor. The Contractor shall initiate and maintain an accident prevention program which shall include but shall not be limited to the establishment and supervision of programs for the education and training of employees in the recognition, avoidance and prevention of unsafe conditions and acts. Contractor shall provide first aid services and medical care to his employees. The Contractor shall develop and maintain an effective fire protection and prevention program and good housekeeping practices at the site of contract performance throughout all phases of construction, repair, alteration, or demolition. Contractor shall require appropriate personal protective equipment in all operations where there is exposure to hazardous conditions. The Engineer may order that the work stop if a condition of immediate danger to the Owner's employees, equipment or if property damage exists. This provision shall not shift responsibility or risk of loss for injuries of damage sustained from the Contractor to Owner, and the Contractor shall remain solely responsible for compliance with all safety requirements and for the safety of all persons and property at the site of Contract performance. The Contractor shall instruct his employees required to handle or use toxic materials or other harmful substances regarding their safe handling and use. The Contractor shall take the necessary precautions to protect pedestrians and motorists from harm, and to prevent disruptions of such traffic due to construction activity.

Contractor shall comply with all applicable Laws and Regulations of any public body having jurisdiction for safety of persons or property and to protect them from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and utility owners when execution of the work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property. All damage, injury or loss to any property caused, directly or indirectly, in whole or part, by Contractor, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the work or anyone for whose acts any of them may be liable, shall be remedied by Contractor. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor that the Work is acceptable.

6.10. EMERGENCIES

In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, Contractor, with or without special instruction or authorization from Owner or the Owner's Representative, is obligated to act to prevent damage, injury or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If the Owner's Representative determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued to document the consequences of such action.

6.11. DRAWINGS

6.11.1. SHOP DRAWINGS, SAMPLES, RFIs, AND SUBMITTAL REVIEW

Contractor shall submit Shop Drawings to Engineer for review and approval as called for in the Technical Specifications or required by the Engineer. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to show Engineer the materials and equipment Contractor proposes to provide and to enable Engineer to review the information. Contractor shall also submit Samples to Engineer for review and approval. Before submitting each Shop Drawing or Sample, Contractor shall have determined and verified: (i) all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar information with respect thereto, (ii) all materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work, and (iii) all information relative to Contractor's sole responsibilities in respect to means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto. Contractor shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples with the requirements of the Work and the Contract Documents. Each submittal will have a transmittal cover sheet identifying the shop drawing name, number, and technical specification reference; will bear a stamp or specific written indication that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal. At the time of submission, Contractor shall give Engineer specific written notice of such variations, if any, that the Shop Drawing or Sample submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to Engineer for review and approval of each such variation.

The Contractor shall maintain a submittal log as mentioned in Article 2.5. The Engineer shall receive updated copies at each progress meeting, and the Engineer shall respond to each submittal within fourteen (14) consecutive calendar days. The Contractor shall maintain a request for information (RFI) log as mentioned in Article 2.5. The Engineer shall receive updated copies at each progress meeting, and the Engineer shall respond to each RFI within fourteen (14) consecutive calendar days. The untimely submission of Submittal or RFIs shall not be grounds for a delay claim from the Contractor.

Engineer's review and approval of Shop Drawings and Samples will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of

the completed Project as a functioning whole as indicated the Contract Documents. Engineer's review and approval will not extend to means, methods, techniques, sequences or procedures of construction (except where a particular means method, technique, sequence or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit as required new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

Engineer's review and approval of Shop Drawings or Samples shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has in writing called Engineer's attention to each such variation at the time of submission and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample approval; nor will any approval by the Engineer relieve the Contractor from responsibility for complying with the requirements of paragraph above discussing field measurements by the Contractor.

Contractor shall furnish required submittals with complete information and accuracy in order to achieve required approval of an item within two (2) submittals. Owner's Representative reserves the right to back charge Contractor, for Engineer's costs for resubmittals that account for a number greater than twenty percent (20%) of the total number of first-time submittals, per the approved initial submittal log. Owner's Representative reserves the right to back charge Contractor for all third submittals. The number of first-time submittals shall be equal to the number of submittals agreed to by Engineer and Contractor. All costs to Engineer involved with subsequent submittal of Shop Drawings, Samples or other items requiring approval will be back charged to Contractor at the rate of 3.0 times direct technical labor cost by deducting such costs from payments due Contractor for Work completed. In the event, that Contractor requests a substitution for a previously approved item, all of Engineer's costs in the reviewing and approval of the substitution will be back charged to Contractor, unless the need for such substitution is beyond the control of Contractor.

6.11.2. AS-BUILT DRAWINGS

The Contractor shall keep and maintain one set of blueprints, As-Built Drawings, in good order and legible condition to be continuously marked-up at the job site. The Contractor shall mark and annotate neatly and clearly all project conditions, locations, configurations and any other changes or deviations which may vary from the details represented on the original Contract Plans, including revisions made necessary by Addenda, Shop Drawings, and Change Orders during the construction process. The Contractor shall record the horizontal and vertical locations, in the plan and profile, of all buried utilities that differ from the locations indicated or which were not indicated on the Contract Plans and buried (or concealed), construction and utility features which are revealed during the construction period. All abandoned during construction pipes and utilities must be clearly identified on the As-Built including the methods used to abandon.

The As-Built Drawings shall be available for inspection by the Engineer, Engineer's Consultant, and the Owner's Representative at all times during the progress of the Project.

The As-Built Drawings shall be reviewed by the Owner's Representative, or his designee, for accuracy and compliance with the requirements of "As-Built Drawings" prior to submittal of the monthly pay requests. The pay requests shall be rejected if the marked-up redline prints do not

conform to the “As-Built Drawings” requirements. As-Built Drawings shall be submitted to the Owner Inspector for approval upon completion of the project and prior to acceptance of final pay request. Final pay request shall not be processed until As-Built Drawings have been reviewed by the Engineer or the Engineer’s Consultant for accuracy and completeness.

Prior to placing new potable water mains in service, the Contractor shall provide the Engineer intersection drawings, as specified for the water mains.

The Owner’s acceptance of the As-Built Drawings does not relieve the Contractor of the sole responsibility for the accuracy and completeness of the As-Built Drawings.

6.11.2.1. General

The Contractor shall prepare an AS-BUILT SURVEY per chapter 5J-17.052, Florida Administrative Code (see definition below), signed and sealed by a Florida registered land surveyor. The Contractor will deliver to the Owner two hard copies of signed and sealed As-Built Drawings and an AutoCAD file.

5J-17.050 Definition: (10)(a) *As-Built Survey: a survey performed to obtain horizontal and/or vertical dimensional data so that constructed improvements may be located and delineated: also known as Record Survey.*

This survey shall be clearly titled “AS-BUILT SURVEY” and shall be signed and sealed by a Florida registered land surveyor. The survey must be delivered to the Owner of Clearwater Construction Division upon substantial completion of the project. If this condition is not met, the Owner will procure the services of a Professional Surveyor and Mapper registered in the State of Florida and will back charge the Contractor a fee of \$1,800 per day or any portion thereof to provide the Owner with the required As-Built Survey.

6.11.2.2. Sanitary and Storm Sewer Piping Systems

1. Manholes and inlets shall be located by survey coordinates (northing, easting, and elevation) based on the approved horizontal and vertical datum or utilize the stationing supplied on the construction plans. New and replaced service connections shall be dimensioned to the nearest downstream manhole. All manholes, cleanouts and catch basin invert and rim elevations, manhole and catch basin dimensions, pipe sizes, and pipe material shall also be noted on the plan view and also on the profile if one exists. The terminal ends of all subdrains, inverts of all pipe in structures, and the flow line of inlets shall also be noted on the plan view and also on the profile if one exists.
2. Pipe materials and areas of special construction shall be noted.

6.11.2.3. Pressure Pipe construction (Water, Reclaimed Water, Force Main)

All pipes shall be located by survey coordinates (northing, easting, and elevation) based on the approved horizontal and vertical datum or utilize the stationing supplied on the construction plans. Coordinates shall be at all pipe bends, tees, valves, reducers, and deflections. Also, all new and replaced service connections for potable and reclaimed water will be located as described above. Additionally, there must be survey coordinates no further than 100 feet apart on linear type construction and shall denote top of pipe elevation at those points.

6.11.2.4. Electrical and Control Wiring

The As-Built Drawings shall include all changes to the original Contract Plans. The As-Built Drawings shall also include the size, color, and number of wires and conduit. For projects where this information is too voluminous to be contained on the blueline prints, the Contractor shall prepare supplemental drawings, on same size sheets as the blueline prints, showing the additional conduit runs, 1-line diagrams, ladder diagrams, and other information. The wiring schematic diagrams shall show termination location and wiring identification at each point on the ladder diagram.

6.11.2.5. Horizontal and Vertical Control

The As-Built Survey shall be based on the original datum used for the construction design plans or if required by the Owner the datum shall be referenced to the North American Datum of 1983/90 (horizontal) and the North American Vertical Datum of 1988. The unit of measurement shall be the United States Foot. Any deviation or use of any other datum, (horizontal and or vertical), must be approved by the Owner of Clearwater Engineering Department.

6.11.2.6. Standards

The As-Built Survey shall meet the Minimum Technical Standards per Chapter 5J-17 and the Clearwater CAD STANDARDS set forth below. In addition to locating all improvements that pertain to the As-Built Survey it is the requirement of the Owner to have minimum location points at every change in direction and no more than 100 feet apart on all pressure pipes.

6.11.2.7. Other

The As-Built Drawings shall reflect any differences from the original Contract Plans, in the same level of detail and units of dimensions as the Plans.

6.11.3. CAD STANDARDS

6.11.3.1. Layer Naming

6.11.3.1.1. Prefixes and Suffixes

AB-...	prefix denotes As-Built information
DI-...	prefix denotes digitized or scanned entities
DEMO-...	prefix denotes demolition
P-...	prefix denotes proposed entities – line work and symbols
F-...	prefix denotes future entities (proposed but not part of this contract) - line work and symbols
X-...	prefix denotes existing entities – line work and symbols
... -CANOPY	Suffix denotes tree canopies
...-CL	suffix denotes centerline of road, ditch, swale etc.
...-LN	suffix denotes all linework
...-PT	suffix denotes points from survey data or from design stakeout
...-TX	suffix denotes text – use for all text, no matter the prefix

6.11.3.1.2. Layer Naming Definitions:

BENCH	benchmark, temporary benchmarks
BLDG	buildings, sheds, finished floor elevation

SECTION III – General Conditions

BOC	curbs
BOLLARD	bollards
BRUSH	brush lines
CABLE	cable TV lines and appurtenances
CONCSLAB	concrete slabs
DRIVE	driveways
EASEMENT	easements
EOP	edge of pavement without curbs
FENCE	all fences
FLOW	flow lines
GRADE	grade slopes, grade breaks
GROUND	soft ground (unpaved, unimproved)
HANDRAIL	handrails
HEDGE	hedges
LANDSCAPE	landscape areas
LOT	platted lot lines information
MISC	miscellaneous linework
MONU	property corners, monumentation
PHONE	telephone lines and appurtenances
PROPERTY	property lines information
ROAD	roads
ROW	Right-of-Way information
SEAWALL	seawalls
SHORE	shoreline, water elevation
SWALE	swales
TOB	top of bank
TOE	toe of slope
TRAFFIC	signal poles, control boxes
TREE	trees, bushes, planters
UT-ELEC	power lines and appurtenances
UT-GAS	gas lines and appurtenances
UT-RCW	reclaimed water
UT-SAN	sanitary lines and appurtenances
UT-STM	storm lines and appurtenances
UT-TCOM	telecommunication systems
UT-WAT	potable water lines and appurtenances, sprinklers
WALK	sidewalk
WALL	walls, except seawall

Other layers may be created as required or needed, using above format or easy to understand logic.

6.11.3.2. Layer Properties

All AutoCAD objects shall be drawn with their General Properties to be “ByLayer”, pertaining to “Color”, “Linetype”, and “Lineweight”.

6.11.3.3. Text Styles

All text shall use standard AutoCAD fonts.

Text style for X-... (existing) layers shall use the Simplex font, oblique angle of 0°, and a text height of 0.06 times the plot scale.

Text style for P-... (proposed) and F-... (future) layers shall use the Simplex font, oblique angle of 22.5°, and a text height of 0.1 times the plot scale.

6.11.4. DELIVERABLES

The As-Built Survey shall be produced on bond material, 24" x 36" at a scale of 1"=20' unless approved otherwise. The consultant shall deliver two hard copies and one digital copy of all drawings. Requested file formats are Autodesk DWG and Adobe PDF files.

Please address any questions regarding format to Mr. Tom Mahony, at (727) 562-4762 or e-mail address Thomas.Mahony@myClearwater.com.

6.12. CONTRACTOR'S GENERAL WARRANTY AND GUARANTEE

Contractor warrants and guarantees to Owner, Engineer and Engineer's Consultants that all Work will be in accordance with the Contract Documents and will not be defective. Contractor's warranty and guarantee hereunder includes defects or damage caused by abuse, vandalism, modification, or operation by persons other than Contractor, Subcontractors or Suppliers. Until the acceptance of the Work by the Owner, the Work shall be under the charge and care of the Contractor, and he shall take every necessary precaution against injury or damage to any part thereof by action of the elements, or from any other cause whatsoever, arising from the execution or non-execution of the Work. The Contractor shall rebuild, repair, and make good, at his own expense, all injuries or damages to any portion of the Work occasioned by any cause before its completion and final acceptance by the Owner. In addition, "the Contractor shall remedy any defects in the work at his own expense and pay for any damage to other work resulting therefrom which appear within a period of one year from the date of final acceptance".

Contractor's warranty and guarantee hereunder excludes improper maintenance and operation by Owner's employees and normal wear and tear under normal usage for any portion of the Work, which has been partially accepted by the Owner for operation prior to final acceptance by the Owner. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents: (i) observations by Owner's Representative, (ii) recommendation of any progress or final payment by Owner's Representative, (iii) the issuance of a certificate of Substantial Completion or any payment by the Owner to contractor under the Contract Documents, (iv) use or occupancy of the Work or any part thereof by Owner, (v) any acceptance by Owner or any failure to do so, (vi) any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of Acceptance by the Engineer.

6.13. CONTINUING THE WORK

Contractor shall carry on the work and adhere to the progress schedule during all disputes or disagreements with the Owner. No work shall be delayed or postponed pending resolution of any disputes or disagreements, except as the Owner or Contractor may otherwise agree in writing.

6.14. INDEMNIFICATION

To the fullest extent permitted by law, Contractor agrees to defend, indemnify, and hold the City, its officers, agents, and employees, harmless from and against any and all liabilities, demands, claims, suits, losses, damages, causes of action, fines or judgments, including costs, attorneys', witnesses', and expert witnesses' fees, and expenses incident thereto, relating to, arising out of, or resulting from: (i) the services provided by Contractor personnel under this Agreement; (ii) any negligent acts, errors, mistakes or omissions by Contractor or Contractor personnel; and (iii) Contractor or Contractor personnel's failure to comply with or fulfill the obligations established by this Agreement.

Contractor will update the City during the course of the litigation to timely notify the City of any issues that may involve the independent negligence of the City that is not covered by this indemnification.

The City assumes no liability for actions of Contractor and will not indemnify or hold Contractor or any third party harmless for claims based on this Agreement or use of Contractor-provided supplies or services.

Notwithstanding anything contained herein to the contrary, this indemnification provision shall not be construed as a waiver of any immunity to which Owner is entitled or the extent of any limitation of liability pursuant to § 768.28, Florida Statutes. Furthermore, this provision is not intended to nor shall be interpreted as limiting or in any way affecting any defense Owner may have under § 768.28, Florida Statutes or as consent to be sued by third parties.

6.15. CHANGES IN COMPANY CONTACT INFORMATION

Contractor shall notify Owner by US mail addressed to the City Engineer of any changes in company contact information. This includes contact phone, address, project manager, email addresses, etc.

6.16. PUBLIC RECORDS

The CONTRACTOR will be required to comply with Section 119.0701, Florida Statutes.

IF THE CONTRACTOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE CONTRACTOR'S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS CONTRACT, CONTACT THE CUSTODIAN OF PUBLIC RECORDS, Rosemarie Call, phone: 727-562-4092 or Rosemarie.Call@myclearwater.com, 600 Cleveland Street, Suite 600, Clearwater, FL 33755.

The Contractor's duty to comply with public records law applies specifically to:

- a) Keep and maintain public records required by the City of Clearwater (hereinafter "public agency") to perform the service being provided by the Contractor hereunder.
- b) Upon request from the public agency's custodian of public records, provide the public agency with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a cost that does not exceed the cost provided for in Chapter 119, Florida Statutes, as may be amended from time to time, or as otherwise provided by law.
- c) Ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law for the

duration of the contract term and following completion of the contract if the Contractor does not transfer the records to the public agency.

- d) Upon completion of the contract, transfer, at no cost, to the public agency all public records in possession of the Contractor or keep and maintain public records required by the public agency to perform the service. If the Contractor transfers all public records to the public agency upon completion of the contract, the Contractor shall destroy any public records that are exempt or confidential and exempt from public records disclosure requirements. If the Contractor keeps and maintains public records upon completion of the contract, the Contractor shall meet all applicable requirements for the retaining public records. All records stored electronically must be provided to the public agency, upon request from the public agency's custodian of public records in a format that is compatible with the information technology systems of the public agency.
- e) A request to inspect or copy public records relating to a public agency's contract for services must be made directly to the public agency. If the public agency does not possess the requested records, the public agency shall immediately notify the Contractor of the request and the Contractor must provide the records to the public agency or allow the records to be inspected or copied within a reasonable time.
- f) The Contractor hereby acknowledges and agrees that if the Contractor does not comply with the public agency's request for records, the public agency shall enforce the contract provisions in accordance with the contract.
- g) A Contractor who fails to provide the public records to the public agency within a reasonable time may be subject to penalties under Section 119.10, Florida Statutes.
- h) If a civil action is filed against a Contractor to compel production of public records relating to a public agency's contract for services, the court shall assess and award against the Contractor the reasonable costs of enforcement, including reasonable attorney fees, if:
 - 1. The court determines that the Contractor unlawfully refused to comply with the public records request within a reasonable time; and
 - 2. At least 8 business days before filing the action, the plaintiff provided written notice of the public request, including a statement that the Contractor has not complied with the request, to the public agency and to the Contractor.
- i) A notice complies with subparagraph (h)2. if it is sent to the public agency's custodian of public records and to the Contractor at the Contractor's address listed on its contract with the public agency or to the Contractor's registered agent. Global Express Guaranteed, or certified mail, with postage or shipping paid by the sender and with evidence of delivery, which may be in an electronic format.
- j) A Contractor who complies with a public records request within 8 business days after the notice is sent is not liable for the reasonable costs of enforcement.

7. OTHER WORK

7.1. RELATED WORK AT SITE

The City reserves the right to have its own forces enter the construction site at any time and perform work as necessary in order to perform infrastructure repair or maintenance, whether related to the project or not. The Contractor will allow complete access to all utility owners for these purposes.

The City may have its own forces perform new work related to the project, however, this work will be identified in the Contract Scope of Work and coordination will be such that this activity is

denoted in the Contractor's CPM Schedule so as not to cause any delays or interference with the Contractor's work or schedule.

7.2. COORDINATION

If the Owner contracts with others for the performance of other work on the Project at the site, the following will be set forth in the Scope of Work: (i) the person who will have authority and responsibility for coordination of the activities among the various prime Contractors will be identified; (ii) the specific matters to be covered by such authority and responsibility will be itemized; and (iii) the extent of such authority and responsibilities will be provided. Unless otherwise provided in the Supplementary Conditions, the Owner shall have sole authority and responsibility in respect of such coordination.

8. OWNER'S RESPONSIBILITY

Except as otherwise provided in these General Conditions, the Owner shall issue all communications from the Owner to the Contractor through Owner's Representative.

The Owner shall furnish the data required of the Owner under the Contract Documents promptly and shall make payments to Contractor promptly when they are due as provided in these General Conditions.

The Owner is obligated to execute Change Orders as indicated in the Article on Changes In The Work.

The Owner's responsibility in respect of certain inspections, tests, and approvals is set forth in the Article on Tests and Inspections.

In connection with the Owner's right to stop work or suspend work, see the Article on Engineer may Stop the Work. The Article on Suspension of Work and Termination deals with the Owner's right to terminate services of Contractor under certain circumstances.

Owner shall not supervise, direct or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences or procedures of construction or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the furnishing or performance of the Work. The Owner will not be responsible for Contractor's failure to perform or furnish the Work in accordance with the Contract Documents.

9. OWNER REPRESENTATIVE'S STATUS DURING CONSTRUCTION

9.1. OWNER'S REPRESENTATIVE

Dependent of the project type, the Owner's Representative during the construction period will either be the Construction Manager, the Engineer, or a designee of the Project's Owner. The duties, responsibilities and the limitations of authority of Owner's Representative during construction are set forth in the Contract Documents and shall not be extended without written consent of Owner and Engineer.

9.2. CLARIFICATIONS AND INTERPRETATIONS

Engineer will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents regarding design issues only, in the form of Submittal responses, RFI responses, Drawings or otherwise, as Engineer may determine necessary, which shall be consistent with the intent of and reasonably inferable from Contract Documents. All other clarifications and interpretations of the Contract Documents shall be issued from the Owner's Representative. Such written clarifications and interpretations will be binding on the Owner and Contractor. If Contractor believes that a written clarification or interpretation justifies an adjustment in the Contract Price or the Contract Time and the parties are unable to agree to the amount or extent thereof, if any, Contractor may make a written claim therefore as provided in the Articles for Change of Work and Change of Contract Time.

9.3. REJECTING OF DEFECTIVE WORK

The Owner's Representative or the Engineer will have authority to disapprove or reject Work which Owner's Representative or the Engineer believes to be defective, or that Owner's Representative or the Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. The Owner's Representative or the Engineer will also have authority to require special inspection or testing of the Work whether or not the Work is fabricated, installed or completed.

9.4. SHOP DRAWINGS, CHANGE ORDERS, AND PAYMENTS

In connection with Engineer's authority as to Shop Drawings and Samples, see articles on Shop Drawings and Samples. In connection with Owner's Representative authority as to Change Orders, see the articles on Changes of Work, Contract Price and Contract Time. In connection with Owner's Representative authority as to Applications for Payment, see the articles on Payments to Contractor and Completion.

9.5. DECISIONS ON DISPUTES

The Owner's Representative will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the work thereunder. Claims, disputes and other matters relating to the acceptability of the work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the work and Claims under the Articles for Changes of Work, Changes of Contract Time and Changes of Contract Price will be referred initially to Owner's Representative in writing with a request for a formal decision in accordance with this paragraph. Written notice of each such claim, dispute or other matter will be delivered by the claimant to Owner's Representative and the other party to the Agreement promptly, but in no event later than thirty (30) days, after the start of the occurrence or event giving rise thereto, and written supporting data will be submitted to Owner's Representative and the other party within sixty (60) days after the start of such occurrence or event unless Owner's Representative allows an additional period of time for the submission of additional or more accurate data in support of such claim, dispute or other matter. The opposing party shall submit any response to Owner's Representative and the claimant within thirty (30) days after receipt of the claimant's last submittal unless Owner's Representative allows additional time. Owner's Representative will render a formal decision in writing within thirty (30) days after receipt of the opposing party's submittal, if any, in accordance with this paragraph. Owner Representative's written decision on such claim, dispute or other matter will be final and binding upon the Owner

and Contractor unless (i) an appeal from Owner Representative's decision is taken within thirty (30) days of the Owner Representative's decision, or the appeal time which may be stated in a Dispute Resolution Agreement between Owner and Contractor for the settlement of disputes or (ii) if no such Dispute Resolution Agreement has been entered into, a written notice of intention to appeal from Owner Representative's written decision is delivered by the Owner or Contractor to the other and to Owner's Representative within thirty (30) days after the date of such decision and a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction to exercise such rights or remedies as the appealing party may have with respect to such claim, dispute or other matter in accordance with applicable Laws and Regulations within sixty (60) days of the date of such decision, unless otherwise agreed in writing by the Owner and Contractor.

When functioning as interpreter and judge, Owner's Representative will not show partiality to the Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by Owner's Representative with respect to any such claim, dispute or other matter will be a condition precedent to any exercise by the Owner or Contractor of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute or other matter pursuant the Article on Dispute Resolution.

9.6. LIMITATIONS ON OWNER REPRESENTATIVE'S RESPONSIBILITIES

Neither Owner Representative's authority or responsibility under this paragraph or under any other provision of the Contract Documents nor any decision made by Owner's Representative in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise or performance of any authority or responsibility by Owner's Representative shall create, impose or give rise to any duty owed by Owner's Representative to Contractor, any Subcontractor, any Supplier, any other person or organization or to any surety for or employee or agent of any of them.

Owner's Representative will not supervise, direct, control or have authority over or be responsible for Contractor's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the furnishing or performance of the work. Owner's Representative will not be responsible for Contractor's failure to perform or furnish the work in accordance with the Contract Documents.

Owner's Representative will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the work.

Owner Representative's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds and certificates of inspection, tests and approvals and other documentation required to be delivered by the Contractor will only be to determine generally that their content complies with the requirements of the Contract Documents and, in the case of certificates of inspections, tests and approvals that the results certified indicate compliance with the Contract Documents.

The limitations upon authority and responsibility set forth in this paragraph shall also apply to Owner Representative's CEI, the Engineer's Consultants, and assistants.

10. CHANGES IN THE WORK

Without invalidating the Agreement and without notice to any surety, the Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such additions, deletions, or revisions will be authorized by a Written Amendment, a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as may otherwise be specifically provided).

If the Owner and Contractor are unable to agree as to the extent, if any, of an adjustment in the Contract Price or an adjustment of the Contract Time that should be allowed as a result of a Work Change Directive, a claim may be made therefore as provided in these General Conditions.

Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Time with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in these General Conditions except in the case of an emergency as provided or in the case of uncovering work as provided in article for Uncovering Work.

The Owner and Contractor shall execute appropriate Change Orders or Written Amendments recommended by Owner's Representative covering:

- changes in the work which are (i) ordered by the Owner (ii) required because of acceptance of defective work under the article for Acceptance of Defective Work or correcting defective Work under the article for Owner May Correct Defective Work or (iii) agreed to by the parties;
- changes in the Contract Price or Contract Time which are agreed to by the parties; and
- changes in the Contract Price or Contract Time which embody the substance of any written decision rendered by Owner's Representative pursuant to the article for Decisions on Disputes;
- provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the progress schedule as provided in the article for Continuing the Work.

If notice of any change affecting the general scope of the work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Time) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be Contractor's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

11. CHANGES IN THE CONTRACT PRICE

11.1. CHANGES IN THE CONTRACT PRICE

The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to Contractor for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by Contractor shall be at Contractor's expense without change in the Contract Price. The Contract Price may only be adjusted by a Change Order or by a Written Amendment. Any claim for an adjustment in the Contract Price shall be based on a written notice of claim stating the general nature of the claim, to be delivered by the party making the claim to the other party and to Owner's Representative or promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise to the claim. Notice of the amount of the claim with supporting

data shall be delivered within sixty (60) days after the start of such occurrence or event, unless Owner's Representative allows additional time for claimant to submit additional or more accurate data in support of the claim, and shall be accompanied by claimant's written statement that the claimed adjustment covers all known amounts to which the claimant is entitled as a result of said occurrence or event. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this paragraph. The value of any Work covered by a Change Order or of any claim for an adjustment in the Contract Price will be determined as follows: (i) where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (ii) where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit), (iii) where the Work is not covered by unit prices contained in the Contract Documents and agreement is reached to establish unit prices for the Work.

Where the work involved is not covered by unit prices contained in the Contract Documents and where the Owner's Representative, the Owner, the Engineer, the Engineer's Consultant, and Contractor cannot mutually agree on a lump sum price, the City of Clearwater shall pay for directed changes in the Work, on "COST REIMBURSEMENT" basis. The Contractor shall apply for compensation, detailing Contractor's forces, materials, equipment, Subcontractors, and other items of direct costs required for the directed work.

The application for Cost Reimbursement shall be limited to the following items:

1. Labor, including foremen, for those hours associated with the direct work (actual payroll cost, including wages, fringe benefits, labor insurance and labor taxes established by law). Expressly excluded from this item are all costs associated with negotiating the subject change.
2. Materials associated with the change, including sales tax. The costs of materials shall be substantiated through vendors' invoices.
3. Rental or equivalent rental costs of equipment, including necessary transportation costs if specifically used for the Work. The rental rates shall not exceed the current rental rates prevailing in the locality or as defined in the rental Rate Blue Book for Construction Equipment (a.k.a. DataQuest Blue Book). The rental rate is defined as the full-unadjusted base rental rate for the appropriate item of construction equipment and shall cover the costs of all fuel, supplies, repairs, insurance, and other costs associated with supplying the equipment for work ordered. Contractor-owned equipment will be paid for the duration of time required to complete the work. Utilize lowest cost combination of hourly, daily, weekly, or monthly rates. Do not exceed estimated operating costs given in Blue Book. Operating costs will not be allowed for equipment on stand-by.
4. Additional costs for Bonds, Insurance if required by the City of Clearwater.

The following fixed fees shall be added to the costs of the directed work performed by the Contractor or Subcontractor.

- A. A fixed fee of fifteen percent (15%) shall be added to the costs of Item 1 above. If work is performed by a Subcontractor, the Contractor's fee shall not exceed five percent (5%), and the Subcontractor's fee shall not exceed ten percent (10%).
- B. A fixed fee of ten percent (10%) shall be added to the costs of Item 2 above.
- C. No markup shall be added to the costs of Items 3 and 4.

The fixed fees shall be considered the full compensation for all cost of general supervision, overhead, profit, and other general expense.

11.2. ALLOWANCES AND FINAL CONTRACT PRICE ADJUSTMENT

It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be furnished and performed for such sums as may be acceptable to Owner and Engineer. Contractor agrees that: (i) the allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and (ii) Contractor's costs for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances and no demand for additional payment on account of any of the foregoing will be valid.

Prior to final payment, an appropriate Change Order will be issued as recommended by Owner's Representative to reflect actual amounts due Contractor on account of Work covered by allowances and all the Work actually performed by the Contractor, and the Contract Price shall be correspondingly adjusted.

11.3. UNIT PRICE WORK

Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the established unit price for each separately identified item of unit price work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Owner's Representative. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item. The Owner or Contractor may make a claim for an adjustment in the Contract Price if: (i) the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Contract Documents; and (ii) there is no corresponding adjustment with respect to any other item of Work; and (iii) if Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or the Owner believes that the Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease. On unit price contracts, Owner endeavors to provide adequate unit quantities to satisfactorily complete the construction of the project. It is expected that in the normal course of project construction and completion that not all unit quantities will be used in their entirety and that a finalizing change order which adjusts contract unit quantities to those unit quantities actually used in the construction of the project will result in a net decrease from the original Contract Price. Such reasonable deduction of final Contract Price should be anticipated by the Contractor in his original bid.

12. CHANGES IN THE CONTRACT TIME

The Contract Time (or Milestones) may only be changed by a Change Order or a Written Amendment. Any claim for an adjustment of the Contract Time (or Milestones) shall be based on written notice delivered by the party making the claim to the other party and to Owner's Representative promptly, but in no event later than thirty (30) days, after the occurrence of the

event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within sixty (60) days after such occurrence, unless Owner's Representative allows an additional period of time to ascertain more accurate data in support of the claim, and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Time (or Milestones) shall be determined by Owner's Representative. No claim for an adjustment in the Contract Time (or Milestones) will be valid if not submitted in accordance with the requirements of this paragraph.

All time limits stated in the Contract Documents are of the essence of the Agreement.

Where Contractor is prevented from completing any part of the work within the Contract Time (or Milestones) due to delay beyond the control of Contractor, the Contract Time (or Milestones) may be extended in an amount equal to the time lost due to such delay if a claim is made therefore as provided in the article for Changes in the

Work. Delays beyond the control of Contractor shall include, but not be limited to, acts by the Owner, acts of utility owners or other contractors performing other work as contemplated by the article for Other Work, fires, floods, epidemics, abnormal weather conditions or acts of God. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

Where Contractor is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of both the Owner and Contractor, an extension of the Contract Time (or Milestones) in an amount equal to the time lost due to such delay shall be Contractor's sole and exclusive remedy for such delay. In no event shall the Owner be liable to Contractor, any Subcontractor, any Supplier, any other person, or to any surety for or employee or agent of any of them, for damages arising out of or resulting from (i) delays caused by or within the control of Contractor, or (ii) delays beyond the control of both parties including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God or acts by utility owners or other contractors performing other work as contemplated by paragraph for Other Work.

13. TESTS AND INSPECTIONS, CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.1. TESTS AND INSPECTION

Contractor shall give Owner's Representative and Engineer timely notice of readiness of the Work for all required inspections, tests or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

Contractor shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents. The costs for these inspections, tests or approvals shall be borne by the Contractor except as otherwise provided in the Contract Documents.

If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested or approved by an employee or other representative of such public body including all Owner Building Departments and Owner Utility Departments, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests or approvals, pay all costs in connection therewith, and furnish Owner's Representative the required certificates of inspection or approval. Unless otherwise stated in the Contract Documents, Owner

permit and impact fees will be waived. Contractor shall also be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work, or of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation of the Work.

If any Work (or the work of others) that is to be inspected tested or approved is covered by Contractor without written concurrence of Owner's Representative, it must, if requested by Owner's Representative, be uncovered for observation. Uncovering Work as provided in this paragraph shall be at Contractor's expense unless Contractor has given Owner's Representative and Engineer timely notice of Contractor's intention to cover the same and Owner's Representative has not acted with reasonable promptness in response to such notice.

13.2. UNCOVERING THE WORK

If any Work is covered contrary to the written request of Owner's Representative, it must, if requested by Owner's Representative, be uncovered for Owner Representative's observation and replaced at Contractor's expense.

If Owner's Representative considers it necessary or advisable that covered Work be observed by Owner's Representative or inspected or tested by others, Contractor, at Owner Representative's request, shall uncover, expose or otherwise make available for observation, inspection or testing as Engineer or Owner's Representative may require, that portion of the Work in question, furnishing all necessary labor, material and equipment. If it is found that such Work is defective, Contractor shall pay all claims, costs, losses and damages caused by, arising out of or resulting from such uncovering, exposure, observation, inspection and testing and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and the Owner shall be entitled to an appropriate decrease in the Contract Price for the costs of the investigation, and, if the parties are unable to agree as to the amount thereof, may make a claim therefore as provided in the article for Change in Contract Price. If, however, such Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Time (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement and reconstruction; and, if the parties are unable to agree as to the amount or extent thereof, Contractor may make a claim therefore as provided the article for Change in Contract Price and Change of Contract Time.

13.3. OWNER'S REPRESENTATIVE MAY STOP THE WORK

If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, Engineer or Owner's Representative may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner's Representative to stop the Work shall not give rise to any duty on the part of Owner's Representative or Owner to exercise this right for the benefit of Contractor or any surety or other party. If the Owner's Representative stops Work under this paragraph, Contractor shall be entitled to no extension of Contract Time or increase in Contract Price.

13.4. CORRECTION OR REMOVAL OF DEFECTIVE WORK

If required by Engineer or Owner's Representative, Contractor shall promptly, as directed, either correct all defective Work, whether or not fabricated, installed or completed, or, if the Work has

been rejected by Engineer or Owner's Representative, remove it from the site and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses and damages caused by or resulting from such correction or removal (including but not limited to all costs of repair or replacement of work of others).

13.5. WARRANTY/CORRECTION PERIOD

If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be defective, Contractor shall promptly, without cost to the Owner and in accordance with the Owner's written instructions; (i) correct such defective Work, or, if it has been rejected by the Owner, remove it from the site and replace it with Work that is not defective and (ii) satisfactorily correct or remove and replace any damage to other Work or the work of others resulting therefrom. If Contractor does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, the Owner may have the defective Work corrected or the rejected. Work removed and replaced, and all claims, costs, losses and damages caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

In special circumstances where a particular item of equipment is placed in continuous service before Final Completion of all the Work, the correction period for that item may start to run from an earlier date if specifically, and expressly so provided in the Specifications or by Written Amendment.

Where defective Work (and damage to other Work resulting therefrom) has been corrected, removed or replaced under this paragraph the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

13.6. ACCEPTANCE OF DEFECTIVE WORK

If, instead of requiring correction or removal and replacement of defective Work, the Owner prefers to accept it, the Owner may do so.

Contractor shall pay all claims, costs, losses, and damages attributable to the Owner's evaluation of and determination to accept such defective Work such costs to be approved by Owner's Representative as to reasonableness. If any such acceptance occurs prior to Owner Representative's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and the Owner shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, the Owner may make a claim therefore as provided in article for Change of Contract Price. If the acceptance occurs after the Owner Representative's recommendation for final payment an appropriate amount will be paid by Contractor to the Owner.

13.7. OWNER MAY CORRECT DEFECTIVE WORK

If Contractor fails within a reasonable time after written notice from Owner's Representative to correct defective Work or to remove and replace rejected Work as required by Owner's Representative in accordance with the article for Correction and Removal of Defective Work or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, the Owner may, after seven

days' written notice to Contractor, correct and remedy any such deficiency. In exercising the rights and remedies under this paragraph the Owner shall proceed expeditiously. In connection with such corrective and remedial action, the Owner may exclude Contractor from all or part of the site, take possession of all or part of the Work, and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the site or for which the Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's Representatives, Agents and Employees, the Owner's other contractors, and Owner's Representative, Engineer, and Engineer's Consultants access to the site to enable the Owner to exercise the rights and remedies under this paragraph. All claims, costs, losses and damages incurred or sustained by the Owner in exercising such rights and remedies will be charged against Contractor and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and the Owner shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, the Owner may make a claim therefore as provided in the article for Change of Contract Price. Such claims, costs, losses and damages will include but not be limited to all costs of repair or replacement of work of others destroyed or damaged by correction, removal or replacement of Contractor's defective Work. Contractor shall not be allowed an extension of the Contract Time (or Milestones) because of any delay in the performance of the Work attributable to the exercise by the Owner of the Owner's rights and remedies hereunder.

14. PAYMENTS TO CONTRACTOR AND COMPLETION

Requests for payment shall be processed in accordance with F.S. 218.735 and as described herein. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.1. APPLICATION FOR PROGRESS PAYMENT

Contractor shall submit (not more often than once a month) to Owner's Representative for review an Application for Payment filled out and signed by Contractor covering the Work completed once each month and accompanied by such supporting documentation as is required by the Owner's Representative and the Contract Documents. Unless otherwise stated in the Contract Documents, payment will not be made for materials and equipment not incorporated in the Work. Payment will only be made for that portion of the Work, which is fully installed including all materials, labor, and equipment. A retainage of not less than five (5%) of the amount of each Application for Payment for the total of all Work, including As-Built Survey and Inspector overtime reimbursement, completed to date will be held until final completion and acceptance of the Work covered in the Contract Documents. No progress payment shall be construed to be acceptance of any portion of the Work under contract.

The Contractor shall review with the Engineer or the Construction Inspector all quantities and work for which payment is being applied for and reach agreement prior to submittal of an Official Pay Request. The Engineer or the Construction Inspector will verify that the on-site marked up As-Built Drawings are up to date with the work and are in compliance with the Contract Documents.

In addition to all other payment provisions set out in this contract, the Owner's Representative may require the Contractor to produce for Owner, within fifteen (15) days of the approval of any progress payment, evidence and/or payment affidavit that all Subcontractors and Suppliers have been paid any sum or sums then due. A failure on the part of the Contractor to provide the report as required herein shall result in further progress or partial payments being withheld until the report is provided.

14.2. CONTRACTOR'S WARRANTY OF TITLE

Contractor warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to the Owner no later than the time of payment, free and clear of liens. No materials or supplies for the Work shall be purchased by Contractor or Subcontractor subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller. Contractor warrants that he has good title to all materials and supplies used by him in the Work, free from all liens, claims or encumbrances. Contractor shall indemnify and save the Owner harmless from all claims growing out of the lawful demands of Subcontractors, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies incurred in the furtherance of the performance of this Contract. Contractor shall at the Owner's request, furnish satisfactory evidence that all obligations of nature hereinabove designated have been paid, discharged, or waived. If Contractor fails to do so, then the Owner may, after having served written notice on said Contractor either pay unpaid bills, of which the Owner has written notice, or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged, whereupon payment to Contractor shall be resumed in accordance with the terms of this Contract, but in no event shall the provisions of this sentence be construed to impose any obligations upon the Owner to the Contractor or the Surety. In paying any unpaid bills of the Contractor, the Owner shall be deemed the agent of Contractor and any payment so made by the Owner shall be considered as payment made under the Contract by the Owner to Contractor, and the Owner shall not be liable to Contractor for any such payment made in good faith.

14.3. REVIEW OF APPLICATIONS FOR PROGRESS PAYMENTS

The Owner's Representative will within twenty (20) business days after receipt authorize and process payment by the Owner a properly submitted and documented Application for payment unless the application requires review by an Agent. If the Application for payment requires review and approval by an Agent, properly submitted and documented Applications for payment will be paid by the Owner within twenty-five (25) business days. If an Application for payment is rejected, notice shall be given within twenty (20) business days of receipt indicating the reasons for refusing payment. The reasons for rejecting an Application will be submitted in writing, specifying deficiencies, and identifying actions that would make the Application proper. In the latter case, Contractor may make the necessary corrections and resubmit the Application. The Owner's Representative or Agent may refuse to recommend the whole or any part of any payment to Owner. Owner's Representative or Agent may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or test, nullify any such payment previously recommended, to such extent as may be necessary in Owner Representative's or Agent's opinion to protect the Owner from loss because: (i) the Work is defective, or completed Work has been damaged requiring correction or replacement, (ii) the Contract Price has been reduced by amendment or Change Order, (iii) the Owner has been required to correct defective Work or complete Work, or (iv) Owner's Representative or Agent has actual knowledge of the occurrence of any of the events enumerated in the article on Suspension of Work and Termination.

The Owner may refuse to make payment of the full amount recommended by the Owner's Representative or Agent because: (i) claims have been made against the Owner on account of Contractor's performance or furnishing of the Work, (ii) Liens have been filed in connection with the Work, except where Contractor has delivered a specific Bond satisfactory to the Owner to

secure the satisfaction and discharge of such Liens, (iii) there are other items entitling the Owner to a set-off against the amount recommended, or (iv) the Owner has actual knowledge of any of the events described in this paragraph. The Owner shall give Contractor notice of refusal to pay in accordance with the time constraints of this section with a copy to the Owner's Representative or Agent, stating the reasons for such actions, and Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by the Owner and Contractor, when Contractor corrects to the Owner's satisfaction the reasons for such action.

14.4. PARTIAL UTILIZATION

Use by the Owner at the Owner's option of any substantially completed part of the Work which (i) has specifically been identified in the Contract Documents, or (ii) Owner, Engineer, Owner's Representative, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by the Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, may be accomplished prior to Final Completion of all the Work subject to the following:

The Owner at any time may request Contractor in writing to permit the Owner to use any such part of the Work which the Owner believes to be ready for its intended use and substantially complete. If Contractor agrees that such part of the Work is substantially complete, Contractor will certify to Owner, Owner's Representative, and Engineer that such part of the Work is substantially complete and request Owner's Representative to issue a certificate of Substantial Completion for that part of the Work. Contractor at any time may notify Owner, Owner's Representative, and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Owner's Representative to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, Owner, Contractor, Owner's Representative, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner, Owner's Representative, and Contractor in writing giving the reasons, therefore. If Engineer considers that part of the Work to be substantially complete, the provisions of the articles for Substantial Completion and Partial Utilization will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

14.5. FINAL INSPECTION

Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Owner's Representative will make a final inspection with Engineer, Owner and Contractor and will within thirty (30) days notify Contractor in writing of particulars in which this inspection reveals that the Work is incomplete or defective. The Owner's Representative will produce a final punch list, deliver it to the Contractor within five (5) days of completion and assign a date for this work to be completed not less than thirty (30) days from delivery of the list. Failure to include any corrective work or pending items does not alter the responsibility of the Contractor to complete all the construction services purchased pursuant to the contract. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.6. FINAL APPLICATION FOR PAYMENT

After Contractor has completed all such corrections to the satisfaction of Owner's Representative and has delivered in accordance with the Contract Documents all maintenance and operating instructions, As-Built, schedules, guarantees, Bonds, certificates or other evidence of insurance

required by the paragraph for Bonds and Insurance, certificates of inspection, Inspector overtime reimbursement as required in the Contract Documents and other documents, Contractor may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied (except as previously delivered) by: (i) all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by paragraph for Bonds and Insurance, and (ii) executed consent of the surety to final payment using the form contained in Section V of the Contract Documents.

Prior to application for final payment, Contractor shall clean and remove from the premises all surplus and discarded materials, rubbish, and temporary structures, and shall restore in an acceptable manner all property, both public and private, which has been damaged during the prosecution of the Work and shall leave the Work in a neat and presentable condition.

14.7. FINAL PAYMENT AND ACCEPTANCE

If through no fault of Contractor, final completion of the Work is significantly delayed and if Owner's Representative so confirms, the Owner shall, upon receipt of Contractor's final Application for payment and recommendation of Owner's Representative, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by the Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph for Bonds and Insurance, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Owner's Representative with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that such payment shall not constitute a waiver of claims.

If on the basis of Owner Representative's observation of the Work during construction and final inspection, and Owner Representative's review of the final Application for Payment and accompanying documentation, all as required by the Contract Documents, Owner's Representative is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Owner's Representative will indicate in writing his recommendation of payment and present the Application to Owner for payment. Thereupon, Owner's Representative will give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of this article. Otherwise, Owner's Representative will return the Application to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application. If the Application and accompanying documentation are appropriate as to form and substance, the Owner shall, within twenty (20) days after receipt thereof pay Contractor the amount recommended by Owner's Representative.

14.8. WAIVER OF CLAIMS

The making and acceptance of final payment will constitute: a waiver of all claims by the Owner against Contractor, except claims arising from unsettled Liens, from defective Work appearing after final inspection, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and a waiver of all claims by Contractor against the Owner other than those previously made in writing and still unsettled.

15. SUSPENSION OF WORK AND TERMINATION

15.1. OWNER MAY SUSPEND THE WORK

At any time and without cause, Owner's Representative may suspend the Work or any portion thereof for a period of not more than ninety (90) days by notice in writing to Contractor, which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be allowed an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes an approved claim therefore as provided in the articles for Change of Contract Price and Change of Contract Time.

15.2. OWNER MAY TERMINATE

Upon the occurrence of any one or more of the following events:

- Contractor persistently fails to perform the work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule as adjusted from time to time);
- Contractor disregards Laws and Regulations of any public body having jurisdiction;
- Contractor violates Article 6.7.1 of this Section III;
- Contractor disregards the authority of Owner's Representative;
- Contractor otherwise violates in any substantial way any provisions of the Contract Documents; or if the Work to be done under this Contract is abandoned, or if this Contract or any part thereof is sublet, without the previous written consent of the Owner, or if the Contract or any claim thereunder is assigned by Contractor otherwise than as herein specified, or at any time Owner's Representative certifies in writing to the Owner that the rate of progress of the Work or any part thereof is unsatisfactory or that the work or any part thereof is unnecessarily or unreasonably delayed;
- Lack of funding. The City's performance and obligation to pay under this Contract is contingent upon an annual appropriation by the Clearwater City Council.

The Owner may, after giving Contractor (and the surety, if any), seven days' written notice and, to the extent permitted by Laws and Regulations, terminate the services of Contractor, exclude Contractor from the site and take possession of the Work and of all Contractor's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which the Owner has paid Contractor but which are stored elsewhere, and finish the Work as the Owner may deem expedient. In such case Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages sustained by the Owner arising out of or resulting from completing the Work such excess will be paid to Contractor.

If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to the Owner. Such claims, costs, losses and damages incurred by the Owner will be reviewed by Owner's Representative as to their reasonableness and when so approved by Owner's Representative incorporated in a Change Order, provided that when exercising any rights or remedies under this paragraph the Owner shall not be required to obtain the lowest price for the Work performed.

Where Contractor's services have been so terminated by the Owner, the termination will not affect any rights or remedies of the Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by the Owner will not release Contractor from liability.

Upon seven (7) days' written notice to Contractor and Owner's Representative, the Owner may, without cause and without prejudice to any other right or remedy of the Owner, elect to terminate the Agreement. In such case, Contractor shall be paid (without duplication of any items):

- for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
- for expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;
- for all claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors, Suppliers and others;
- and for reasonable expenses directly attributable to termination.

Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.3. CONTRACTOR MAY STOP WORK OR TERMINATE

If, through no act or fault of Contractor, the Work is suspended for a period of more than ninety (90) days by the Owner or under an order of court or other public authority, or the Owner's Representative fails to act on any Application for Payment within thirty (30) days after it is submitted or the Owner fails for thirty (30) days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven (7) days' written notice to the Owner and Owner's Representative, and provided the Owner or Owner's Representative does not remedy such suspension or failure within that time, terminate the Agreement and recover from the Owner payment on the same terms as provided in the article for the Owner May Terminate. However, if the Work is suspended under an order of court through no fault of Owner, the Contractor shall not be entitled to payment except as the Court may direct. In lieu of terminating the Agreement and without prejudice to any other right or remedy, if Owner's Representative has failed to act on an Application for Payment within thirty (30) days after it is submitted, or the Owner has failed for thirty (30) days to pay Contractor any sum finally determined to be due, Contractor may upon seven (7) days' written notice to the Owner and Owner's Representative stop the Work until payment of all such amounts due Contractor. The provisions of this article are not intended to preclude Contractor from making claim under paragraphs for Change of Contract Price or Change of Contract Time or otherwise for expenses or damage directly attributable to Contractor's stopping Work as permitted by this article.

16. DISPUTE RESOLUTION

If and to the extent that the Owner and Contractor have agreed on the method and procedure for resolving disputes between them that may arise under this Agreement, such dispute resolution method and procedure will proceed. If no such agreement on the method and procedure for resolving such disputes has been reached, subject to the provisions of the article for Decisions on Disputes, the Owner and Contractor may exercise such rights or remedies as either may otherwise

have under the Contract Documents or by Laws or Regulations in respect of any dispute provided, however, that nothing herein shall require a dispute to be submitted to binding arbitration.

17. MISCELLANEOUS

17.1. SUBMITTAL AND DOCUMENT FORMS

The form of all submittals, notices, change orders, pay applications, logs, schedules and other documents permitted or required to be used or transmitted under the Contract Documents shall be determined by the Owner's Representative subject to the approval of Owner.

17.2. GIVING NOTICE

Whenever any provision of the Contract Documents requires the giving of written notice, notice will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.3. NOTICE OF CLAIM

Should the Owner or Contractor suffer injury or damage to person or property because of any error, omission or any act of the other party or of any of the other party's officers, employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.

17.4. PROFESSIONAL FEES AND COURT COSTS INCLUDED

Whenever reference is made to "claims, costs, losses and damages," the phrase shall include in each case, but not be limited to, all fees and charges of engineers, architects, attorneys and other professionals and all court or other dispute resolution costs.

17.5. ASSIGNMENT OF CONTRACT

The Contractor shall not assign this contract or any part thereof or any rights thereunder without the approval of Owner, nor without the consent of surety unless the surety has waived its rights to notice of assignment.

17.6. RENEWAL OPTION

Annual Contracts issued through the Engineering Department may be renewed for up to three (3) years, upon mutual consent of both the Owner and the Contractor/Vendor. All terms, conditions and unit prices shall remain constant unless otherwise specified in the contract specifications or in the Invitation to bid. Renewals shall be made at the sole discretion of the Owner and must be agreed to in writing by both parties. All renewals are contingent upon the availability of funds, and the satisfactory performance of the Contractor as determined by the Construction Department.

17.7. ROLL-OFF CONTAINERS AND/OR DUMPSTERS

All City construction projects shall utilize City of Clearwater Solid Waste roll-off containers and/or dumpsters for their disposal and hauling needs. For availability or pricing contact City of Clearwater, Solid Waste Department, by phone: (727) 562-4929.

18. ORDER AND LOCATION OF THE WORK

The City reserves the right to accept and use any portion of the work whenever it is considered to the public interest to do so. The Engineer shall have the power to direct on what line or street the Contractor shall work and order thereof.

19. MATERIAL USED

All material incorporated into the final work shall be new material unless otherwise approved by the Engineer. If requested by the Engineer, the Contractor shall furnish purchase receipts of all materials.

20. CONFLICT BETWEEN PLANS AND SPECIFICATIONS

The various Contract Documents shall be given precedence, in case of conflict, error or discrepancy, as follows: Modifications, Contract Agreement, Addenda, Supplementary General Conditions, General Conditions, Supplementary Technical Specifications and Technical Specifications. In a series of Modifications or Addenda the latest will govern. In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by addendum, the better quality, more stringent or greater quantity of Work shall be provided in accordance with the Engineer/Architect's interpretation.

21. OWNER DIRECT PURCHASE (ODP)

21.1. SALES TAX SAVINGS

The Owner reserves the right to purchase certain portions of the materials or equipment for the Project directly in order to save applicable sales tax in compliance with Florida Law since owner is exempt from the payment of sales tax. The contract price includes Florida sales and other applicable taxes for materials, supplies, and equipment which will be a part of the Contractor's Work. Owner-purchasing of construction materials or equipment, if selected, will be administered on a deductive Change Order basis. The contract price shall be reduced by the actual cost of the materials or equipment purchased by owner plus the normally applicable sales tax, even if the actual cost is in excess of the cost for the materials or equipment as-bid by the Contractor. For purposes of calculating Engineering Fees, Contractor Fees, Architects' Fees, and any other amounts that are based on the contract amount, however, the original, as-bid contract amount shall be used.

Direct purchase shall be considered for single items or materials that exceed \$10,000 in value and/or items identified in Section V, Bidders Proposal. The Contractor shall provide the Owner an ODP Summary of all intended suppliers, vendors, equipment, and materials for consideration as ODP materials or equipment (refer to ODP Instructions in Contract Appendix).

21.2. TITLE AND OWNER RISK

Owner will issue Purchase Orders and provide a copy of Owner's Florida Consumer Certification of Tax Exemption and Certificate of Entitlement directly to the Vendor for ODP materials or equipment. Invoices for ODP materials or equipment shall be issued to the Owner, and a copy sent to the Contractor.

Notwithstanding the transfer of ODP materials or equipment by the Owner to the Contractor's possession, the Owner shall retain legal and equitable title to any and all ODP materials or equipment; therefore, the owner assumes the risk of damage or loss at the time of purchase or delivery of items, unless material is damaged as the result of negligence by the Contractor.

21.3. CONTRACTOR'S RECEIPT OF MATERIALS

The Contractor shall be fully responsible for all matters relating to the receipt of materials or equipment furnished to the Owner including, but not limited to, verifying correct quantities, verifying documents of orders in a timely manner, coordinating purchases, providing and obtaining all warranties and guarantees required by the Contract Documents, and inspection and acceptance of the goods at the time of delivery. The Owner shall coordinate with Contractor and Vendor delivery schedules, sequence of delivery, loading orientation, and other arrangements normally required by the Contractor for the particular materials or equipment furnished. The Contractor shall provide all services required for the unloading and handling of materials or equipment. The Contractor agrees to indemnify and hold harmless the Owner from any and all claims of whatever nature resulting from non-payment of goods to suppliers arising from the action of the Contractor.

As ODP materials or equipment are delivered to the job site, the Contractor shall visually inspect all shipments from the suppliers and approve the vendor's invoice for items delivered. The Contractor shall assure that each delivery of ODP materials or equipment is accompanied by documentation adequate to identify the Purchase Order against which the purchase is made. This documentation may consist of a delivery ticket and/or an invoice from the supplier conforming to the Purchase Order together with such additional information as the Owner may require. The Contractor will then forward an electronic copy of the invoice and supporting documentation to the Owner for payment within fourteen (14) calendar days of receipt of said goods or materials. Such payment shall be directly from public funds, from Owner to Vendor.

The Contractor shall insure that ODP materials or equipment conform to the Specifications and determine prior to acceptance of goods at time of delivery if such materials or equipment are patently defective, and whether such materials or equipment are identical to the materials or equipment ordered and match the description on the bill of lading. If the Contractor discovers defective or non-conformities in ODP materials or equipment upon such visual inspection, the Contractor shall not utilize such nonconforming or defective materials or equipment in the Contractor's Work and instead shall properly notify the Owner of the defective or nonconforming condition so that repair or replacement of those materials or equipment can occur without undue delay or interruption to the Project. If the Contractor fails to perform such inspection and otherwise incorporates into the Contractor's Work such defective or nonconforming ODP materials or equipment, the condition of which it either knew or should have known by performance of an inspection, Contractor shall be responsible for all damages to the Owner, resulting from Contractor's incorporation of such materials or equipment into the Project, including liquidated damages.

21.4. ODP RECORDS, WARRANTIES, AND INDEMNIFICATION

The Contractor shall maintain records of all ODP materials or equipment it incorporates into Contractor's Work from the stock of ODP materials or equipment in its possession. The Contractor shall account monthly to the Owner for any ODP materials or equipment delivered into the Contractor's possession, indicating portions of all such materials or equipment which have been incorporated in the Contractor's Work.

The Contractor shall be responsible for obtaining and managing all warranties and guarantees for all materials, equipment and products as required by the Contract Documents. All repair, maintenance, or damage-repair calls shall be forwarded to the Contractor for resolution with the appropriate supplier, vendor, or Subcontractor.

The Owner shall indemnify and hold Contractor harmless from any sales tax (and interest and penalties incurred in connection therewith) in the event there is a final determination that purchases made by Owner, which Owner treats as being exempt from sales tax, are subject to sales tax. "Final determination" shall mean an assessment by the Department of Revenue that is no longer subject to protest, or a determination of a court having jurisdiction over such matters that is final and not subject to appeal. Contractor agrees to promptly notify owner of any audit, assessment, proposed assessment or notice of deficiency issued with regard to the Project and relating to ODP materials or equipment. ODP Purchase Orders must be closed out prior to closing out the contract/Contractor Purchase Order. If material costs needed for project exceed the ODP Purchase Order amount, the ODP Purchase Order will not be increased. Amounts in excess of the ODP Purchase Order will be paid for by the Contractor.


22. RESIDENT NOTIFICATION OF START OF CONSTRUCTION

22.1. GENERAL

The Contractor shall notify all residents along the construction route or within a 500-foot radius, unless stated otherwise in the Contract Documents, with a printed door hanger notice indicating the following information about the proposed construction work and the Contractor performing the work: City seal or logo; the scheduled date for the start of construction; the type of construction; general sequence and scheduling of construction events; possibility of water service disruption and/or colored water due to construction efforts; Contractor's name, the Superintendent's name, Contractor address and telephone number; Contractor's company logo (optional); requirement for residents to remove landscaping and/or other private appurtenances which are in conflict with the proposed construction; and other language as appropriate to the scope of Contract work. Sample door hanger including proposed language shall be approved by the City prior to the start of construction. Notification shall be printed on brightly colored and durable card stock and shall be a minimum of 4-1/4 by 11 inches in size. Notification (door hanger) shall be posted to residences and businesses directly affected by the Contractor's activities no later than seven (7) days prior to the start of construction activity. Directly affected by the Contractor's activities shall mean all Contractor operations including staging areas, equipment and material storage, principal access routes across private property, etc. Contractor cannot start without proper seven (7) day notice period to residents. Contractor is required to maintain sufficient staff to answer citizen inquiries during normal business hours and to maintain appropriate message recording equipment to receive citizen inquires after business hours.

Resident notification by the Contractor is a non-specific pay item to be included in the bid items provided in the contract proposal.

22.2. EXAMPLE



CLEARWATER
BRIGHT AND BEAUTIFUL · BAY TO BEACH

NOTICE OF CONSTRUCTION
TODAY'S DATE: ___/___/___

PLEASE EXCUSE US FOR ANY INCONVENIENCE

We are the construction contractor performing the *(state project name)* for the City of Clearwater in your area. The work will be performed in the public right-of-way adjacent to your property. This notice is placed a minimum of seven (7) days in advance of construction to notify property owners of the pending start of construction.

(Brief description of the construction process to be expected by the property owners)

The construction process may necessitate the removal of certain items from the right-of-way. Typical items such as sprinklers, grass, and postal approved mailboxes will be replaced by the contractor within a reasonably short period of time. The replacement of driveways and sidewalks will be made using standard asphalt or concrete materials. The property owner is responsible for the expense and coordination to replace driveways and sidewalks which have customized colors, textures and/or materials. Small trees, shrubs, landscaping materials, unauthorized mailboxes or structures within the right-of-way which must be removed due to the construction process will not be replaced. The property owner is responsible to relocate any such items which the property owner wishes to save prior to the start of construction. Vehicles parked on the streets or within the right-of-way may be required to be placed elsewhere.

We are available to answer any questions you may have regarding the construction process or any particular item that must be relocated. Please contact our Construction Manager _____ at (727) _____. We will be more than happy to assist you.

Construction is anticipated to begin on: _____.

Company Name
Company Address
Contractor Phone Number

23. PROJECT INFORMATION SIGNS

23.1. SCOPE AND PURPOSE

The Owner desires to inform the general public on the Owner's use and expenditure of public funding for general capital improvement and maintenance projects. To help accomplish this purpose, the Contractor is required to prepare and display public project information signs during the full course of the contract period. These signs will be displayed at all location(s) of active work. Payment to Contractor for the preparation, installation and management of project sign(s) shall be

included in the cost of the work. The number of and type of signs will be stated in SECTION IV, SCOPE OF WORK.

23.2. PROJECT SIGN, FIXED OR PORTABLE

Sign type shall be "fixed" on stationary projects and "portable" on projects which have extended locations or various locations. The particular wording to be used on the signs will be determined after contract award has been approved. Contractor will be provided the wording to be used on sign at the preconstruction conference.

23.3. FIXED SIGN

Fixed sign shall be 4-foot by 6-foot (4'x6') in size. Sign material shall be Aluminum DIBOND or exterior grade plywood with a minimum thickness of 1/2-inches painted white on both sides with exterior rated paint. Sign shall be attached to a minimum of two (2) 4-inch by 4-inch (3½"x3½") below grade pressure treated (P.T.) wooden posts and braced as necessary for high winds. Posts shall be long enough to provide secure anchoring in the ground. Bottom of sign must be a minimum of 24-inches above the ground. Alternate mounting system or attachment to fencing or other fixed structure can be considered for approval.

23.4. PORTABLE SIGNS

Portable sign shall be a minimum of 24-inches by 30-inches (24"x30") in size and will be attached to a standard sized portable traffic barricade. Sign material shall be aluminum, 0.080-inches or thicker, background of white reflective sheeting, and shall be silkscreen or vinyl lettering. Portable sign shall be two signs located and attached to each side of the traffic barricade.

23.5. SIGN COLORING

Background shall be white. Project Descriptive Name shall be in blue lettering. All other lettering shall be black. Basic lettering on sign shall be in all capital letters, of size proportional to the sign itself. Each sign shall depict the City's logo. The Project Manager/City Representative shall provide the appropriate electronic logo file(s) to the Contractor.

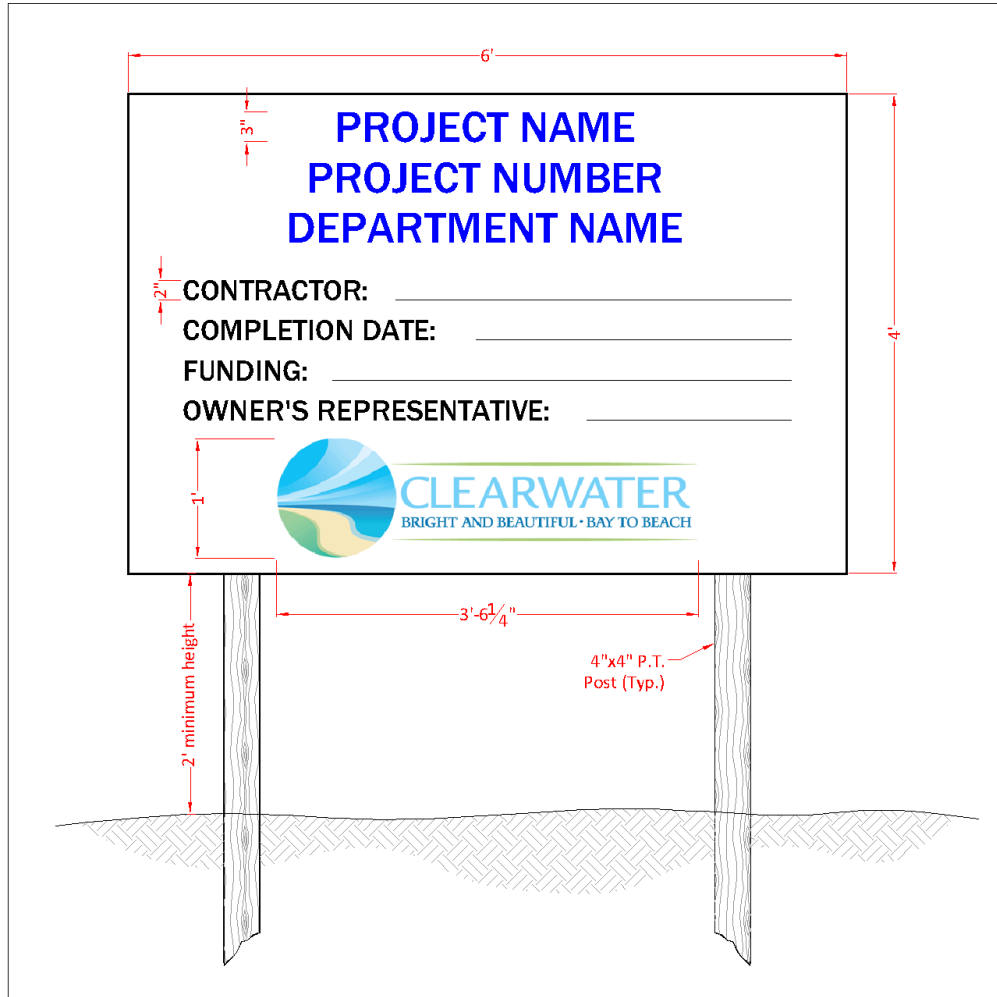
23.6. SIGN PLACEMENT

Signs shall be placed where they are readily visible by the general public which pass by the project site. Signs are not to be placed where they may become a hazard or impediment to either pedestrian or vehicular traffic. For construction projects outside of the Owner's right-of-way, the signs will be placed on the project site. For projects constructed inside of the Owner's right-of-way, the signs will be placed in the right-of-way. Portable signs are to be moved to the locations of active work on the project. Multiple portable signs will be necessary where work is ongoing in several locations at the same time. Fixed signs are to be placed at the start of construction and will remain in place until the request for final payment.

23.7. SIGN MAINTENANCE

The Contractor is responsible for preparation, installation, movement, maintenance, replacement, removal, and disposal of all project signs during the full course of the contract period. The Contractor will place and secure portable signs from dislocation by wind or other actions. Signs are to be cleaned as necessary to maintain legibility and immediately replaced if defaced.

23.8. TYPICAL PROJECT SIGN



Project Sign Details:

Font Type: Franklin Gothic Medium, (ALL CAPS)
 Font Colors: Blue - Pantone 3015 and Black.

24. AWARD OF CONTRACT, WORK SCHEDULE AND GUARANTEE

It will be required that the work will commence not later than five (5) calendar days after the Engineer gives written Notice to Proceed (NTP), which notice shall be given as outlined in Article 2 of these General Conditions.

It is further required that all work within this contract be completed within the indicated number of consecutive calendar days as determined in Section IV, Scope of Work. Contract Time to commence at start date noted on the Notice to Proceed. If the Contractor fails to complete the work within the stipulated time, the City will retain the amount stated in the Contract, per calendar day, for each day that the contract remains incomplete. The work shall be discontinued on Saturdays, Sundays, and approved Holidays. If it becomes necessary for the Contractor to perform work on Saturdays, Sundays, and approved City of Clearwater Employee Holidays, that in the opinion of the Engineer, will require the presence of Inspectors, the Contractor shall pay the City of

Clearwater, Florida, the amount of Four Hundred Eighty Dollars (\$480.00) per each eight-hour (8) day for each Inspector given such assignment.

The Contractor shall remedy any defects in the work at his own expense and pay for any damage to other work resulting therefrom which appear within a period of one (1) year from the date of final acceptance.

25. SCRUTINIZED COMPANIES AND BUSINESS OPERATIONS WITH CUBA AND SYRIA CERTIFICATION FORM AND ISRAEL CERTIFICATION FORM

Pursuant to Section 287.135, Florida Statutes, any vendor, company, individual, principal, subsidiary, affiliate, or owner on the Scrutinized Companies with Activities in Sudan List, the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List, or is engaged in business operations in Cuba or Syria, is ineligible for, and may not bid on, submit a proposal for, or enter into or renew a contract with the City of Clearwater for goods or services for an amount equal to or greater than one million (\$1,000,000.00) dollars. Any vendor, company, individual, principal, subsidiary, affiliate, or owner on the Scrutinized Companies that Boycott Israel List, or is engaged in a boycott of Israel, is ineligible for, and may not bid on, submit a proposal for, or enter into or renew a contract with the City of Clearwater for goods or services for ANY amount.

Each entity submitting a bid, proposal, or response to a solicitation must certify to the City of Clearwater that it is not on the aforementioned lists, or engaged in business operations in Cuba or Syria, or engaged in a boycott of Israel at the time of submitting a bid, proposal or response, in accordance with Section 287.135, Florida Statutes. Business Operations means, for purposes specifically related to Cuba or Syria, engaging in commerce in any form in Cuba or Syria, including, but not limited to, acquiring, developing, maintaining, owning, selling, possessing, leasing or operating equipment, facilities, personnel, products, services, personal property, real property, military equipment, or any other apparatus of business or commerce. Boycott Israel or boycott of Israel means refusing to deal, terminating business activities, or taking other actions to limit commercial relations with Israel, or persons or entities doing business in Israel or in Israeli-controlled territories, in a discriminatory manner. A statement by a company that it is participating in a boycott of Israel, or that it has initiated a boycott in response to a request for a boycott of Israel or in compliance with, or in furtherance of, calls for a boycott of Israel, may be considered as evidence that a company is participating in a boycott of Israel.

The certification forms (the Certification) are attached hereto, and must be submitted, along with all other relevant contract documents, at the time of submitting a bid, proposal, or response. Failure to provide the Certification may deem the entity's submittal non-responsive. If the City of Clearwater determines that an entity has submitted a false certification form, been placed on the Scrutinized Companies with Activities in Sudan List or the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List or the Scrutinized Companies that Boycott Israel List, or engaged in business operations in Cuba or Syria, or engaged in a boycott of Israel, then the contract may be terminated at the option of the City of Clearwater. Other than the submission of a false certification, the City of Clearwater, on a case-by-case basis and in its sole discretion, may allow a company to bid on, submit a proposal for, or enter into or renew a contract for goods or services, if the conditions set forth in Section 287.135, Florida Statutes, apply.

The City retains the right to pursue civil penalties and any other applicable rights and remedies as provided by law for the false submission of the attached certification forms.

See Section V of the Contract for Certification Forms to be executed and submitted with the Bid/Proposal Form.

SECTION IV

TECHNICAL SPECIFICATIONS

Table of Content:

100 SERIES: GENERAL	1
101. SCOPE OF WORK	1
102. FIELD ENGINEERING.....	1
102-1. LINE AND GRADE PERFORMED BY THE CONTRACTOR	1
102-2. LINE AND GRADE PERFORMED BY THE CITY	2
103. DEFINITION OF TERMS	2
103-1. REFERENCE STANDARDS	2
104. STREET CROSSINGS, ETC.	3
105. AUDIO/VIDEO RECORDING OF WORK AREAS	3
105-1. CONTRACTOR TO PREPARE AUDIO/VIDEO RECORDING	3
105-2. SCHEDULING OF AUDIO/VIDEO RECORDING	3
105-3. PROFESSIONAL VIDEOGRAPHERS	3
105-4. EQUIPMENT	3
105-5. RECORDED AUDIO INFORMATION.....	3
105-6. RECORDED VIDEO INFORMATION	4
105-7. VIEWER ORIENTATION	4
105-8. LIGHTING	4
105-9. SPEED OF TRAVEL	4
105-10. VIDEO LOG/INDEX.....	4
105-11. AREA OF COVERAGE	4
105-12. COSTS OF VIDEO SERVICES	5
106. STREET SIGNS	5
107. WORK ZONE TRAFFIC CONTROL	5
107-1. CONTRACTOR RESPONSIBLE FOR WORK ZONE TRAFFIC CONTROL.....	5
107-2. WORK ZONE TRAFFIC CONTROL PLAN	5
107-3. ROADWAY CLOSURE GUIDELINES	6
107-4. APPROVAL OF WORK ZONE TRAFFIC CONTROL PLAN	7
107-5. INSPECTION OF WORK ZONE TRAFFIC CONTROL OPERATION	7
107-6. PAYMENT FOR WORK ZONE TRAFFIC CONTROL.....	7
107-7. CERTIFICATION OF WORK ZONE TRAFFIC CONTROL SUPERVISOR	7
108. OVERHEAD ELECTRIC LINE CLEARANCE.....	8
108-1. CLEARANCE OPTIONS	8
108-2. REQUIRED MINIMUM CLEARANCE DISTANCES.....	8
200 SERIES: SITEWORK	9
201. EXCAVATION FOR UNDERGROUND INFRASTRUCTURE WORK.....	9
201-1. EXCAVATION, BACKFILLING, AND COMPACTION FOR UNDERGROUND INFRASTRUCTURE.....	10
202. OBSTRUCTIONS	21

SECTION IV – Technical Specifications

203.	DEWATERING	22
203-1.	GENERAL	22
203-2.	OBSERVATION WELLS	23
203-3.	PUMPING AND DRAINAGE - GENERAL.....	23
203-4.	PERMIT REQUIREMENTS	27
204.	UNSUITABLE MATERIAL REMOVAL	28
204-1.	BASIS OF MEASUREMENT	28
204-2.	BASIS OF PAYMENT	28
205.	UTILITY TIE IN LOCATION MARKING	28
206.	CLEARING AND GRUBBING.....	28
206-1.	BASIS OF MEASUREMENT	29
206-2.	BASIS OF PAYMENT	29
207.	EROSION AND SEDIMENT CONTROL	29
207-1.	GENERAL	29
207-2.	TRAINING OF PERSONNEL	29
207-3.	STABILIZATION OF DENUDED AREAS	29
207-4.	PROTECTION AND STABILIZATION OF SOIL STOCKPILES.....	30
207-5.	PROTECTION OF EXISTING STORM SEWER SYSTEMS	30
207-6.	SWALES, DITCHES AND CHANNELS	30
207-7.	UNDERGROUND UTILITY CONSTRUCTION.....	30
207-8.	MAINTENANCE.....	30
207-9.	COMPLIANCE.....	30
208.	CONSTRUCTION AND REPAIR OF SEAWALLS AND OTHER BEACH EROSION CONTROL STRUCTURES	31
208-1.	EXISTING SEAWALLS AND REVETMENTS	31
208-2.	TOP OF CAP ELEVATION	31
208-3.	SEAWALLS AND REVETMENTS LOCATED SEAWARD OF THE CCL.....	31
208-4.	PLACEMENT OF NEW SEAWALL.....	31
208-5.	POST CONSTRUCTION SURVEY	32
208-6.	RIP-RAP.....	32
208-7.	RETAINING WALL IN LIEU OF VERTICAL SEAWALL.....	32
209.	MAINTENANCE OF OPERATIONS	32
209-1.	GENERAL	32
209-2.	EXECUTION	32
209-3.	BASIS OF MEASUREMENT	34
210.	DETECTION OF FACILITIES.....	34
211.	RELOCATIONS	35
211-1.	RELOCATION SHOWN ON DRAWINGS.....	35
211-2.	RELOCATIONS NOT SHOWN ON DRAWINGS	35
212.	RESTORATION PROCEDURES	35
212-1.	INTERIM RESTORATION.....	35
212-2.	FINAL RESTORATION	35
300 SERIES:	MATERIALS.....	37
301.	CONCRETE	37
302.	EXCAVATION AND FORMS FOR CONCRETE WORK	37

SECTION IV – Technical Specifications

302-1.	EXCAVATION.....	37
302-2.	FORMS	37
303.	REINFORCEMENT.....	37
303-1.	BASIS OF PAYMENT	38
304.	BACKFILL.....	38
304-1.	MATERIALS AND GENERAL.....	38
304-2.	TESTING AND INSPECTION	38
305.	RIPRAP	39
305-1.	BASIS OF MEASUREMENT	39
305-2.	BASIS OF PAYMENT	39
306.	FLOWABLE FILL	40
307.	MATERIAL INDEPENDENT TESTING.....	41
400 SERIES:	SANITARY SEWER.....	42
401.	SANITARY MANHOLES	42
401-1.	BUILT UP TYPE	42
401-2.	PRECAST TYPE	43
401-3.	DROP MANHOLES	45
401-4.	FRAMES AND COVERS.....	45
401-5.	MANHOLE COATINGS.....	45
401-6.	CONNECTIONS TO MANHOLES	45
401-7.	MEASUREMENT AND PAYMENT.....	45
402.	RAISING OR LOWERING OF SANITARY SEWER STRUCTURES	45
402-1.	BASIS OF PAYMENT	45
403.	SANITARY SEWERS AND FORCE MAINS.....	45
403-1.	MATERIALS	45
403-2.	INSTALLATION.....	46
403-3.	INSPECTIONS OF LINES AND MANHOLES	46
403-4.	TESTING	48
403-5.	BASIS OF PAYMENT	48
404.	CURED-IN-PLACE PIPE SANITARY SEWER REHABILITATION.....	49
404-1.	GENERAL	49
404-2.	MEASUREMENT & PAYMENT	50
404-3.	SUBMITTALS.....	50
404-4.	CURED-IN-PLACE PIPE (CIPP) FOR GRAVITY SEWER MAINS.....	51
404-5.	CURED-IN-PLACE PIPE (CIPP) FOR SERVICE LATERALS.....	54
405.	SANITARY MANHOLE LINER RESTORATION	58
405-1.	SCOPE AND INTENT	58
405-2.	MEASUREMENT & PAYMENT	59
405-3.	CEMENTITIOUS COATING SYSTEM.....	60
405-4.	RAVEN 405 EPOXY COATING SYSTEM	64
405-5.	SPRAYWALL POLYURETHANE COATING SYSTEM.....	68
405-6.	INTERNAL MANHOLE CORBEL SEALING SYSTEM.....	72
406.	SMOKE AND DYE TESTING.....	75
406-1.	GENERAL PROTOCOL	75
406-2.	REPORTING.....	75

SECTION IV – Technical Specifications

406-3.	DYE INVESTIGATION	77
406-4.	MEASUREMENT AND PAYMENT	79
406-5.	BASIS OF PAYMENT	79
500 SERIES: POTABLE AND RECLAIMED WATER MAINS, FIRE LINES AND APPURTENANCES		80
501.	SCOPE	80
502.	MATERIALS	80
502-1.	GENERAL	80
502-2.	PIPE MATERIALS AND FITTINGS	80
502-3.	GATE VALVES	92
502-4.	VALVE BOXES	93
502-5.	HYDRANTS	94
502-6.	SERVICE SADDLES/ POLYETHYLENE SERVICE LINES	95
502-7.	BACKFLOW PREVENTERS	96
502-8.	TAPPING SLEEVES AND LINSTOPS	96
502-9.	LINE STOPPING ASSEMBLIES	98
502-10.	BLOW OFF HYDRANTS	99
503.	CONSTRUCTION	99
503-1.	MATERIAL HANDLING	99
503-2.	PIPE LAYING	100
503-3.	SETTING OF VALVES, HYDRANTS AND FITTINGS	118
503-4.	CONNECTIONS TO EXISTING POTABLE WATER OR RECLAIMED WATER LINES	121
504.	PIPELINE CLEANING	122
504-1.	PIPELINE PIGGING	122
504-2.	FINAL PIPELINE FLUSHING	123
505.	TESTS	123
505-1.	HYDROSTATIC PIPELINE TESTING	123
505-2.	NOTICE OF TEST	124
506.	DISINFECTION AND TESTING	124
506-1.	DISINFECTION MATERIALS	124
506-2.	FLUSHING SYSTEM	125
506-3.	FINAL DISINFECTION PROCEDURE FOR POTABLE WATER MAINS	125
506-4.	FLUSHING AND RESIDUAL CHLORINE TESTS	127
506-5.	BACTERIOLOGICAL TESTS	127
507.	CORRECTION OF NON-CONFORMING WORK	128
508.	OBTAINING WATER FOR FLUSHING AND TESTING	128
509.	MEASUREMENT AND PAYMENT	128
509-1.	GENERAL	128
509-2.	FURNISH AND INSTALL WATER MAINS	129
509-3.	FURNISH AND INSTALL FITTINGS	129
509-4.	FURNISH AND INSTALL GATE VALVES COMPLETE WITH BOXES AND COVERS	129
509-5.	FURNISH AND INSTALL FIRE HYDRANTS	129
600 SERIES: STORMWATER.....		131

SECTION IV – Technical Specifications

601.	RAISING OR LOWERING OF STORM DRAINAGE STRUCTURES.....	131
601-1.	BASIS OF PAYMENT	131
602.	UNDERDRAINS.....	131
602-1.	BASIS OF MEASUREMENT	131
602-2.	BASIS OF PAYMENT	131
603.	STORM SEWERS.....	132
603-1.	TESTING AND INSPECTION	132
603-2.	BASIS OF PAYMENT	132
604.	STORM MANHOLES, INLETS, CATCH BASINS OR OTHER STORM STRUCTURES.....	133
604-1.	BUILT UP TYPE STRUCTURES.....	133
604-2.	PRECAST TYPE	133
604-3.	BASIS OF PAYMENT	134
605.	GABIONS AND MATTRESSES.....	134
605-1.	MATERIAL	134
605-2.	PERFORMANCE	135
700 SERIES: STREETS AND SIDEWALKS		136
701.	RESTORATION OR REPLACEMENT OF DRIVEWAYS, CURBS, SIDEWALKS AND STREET PAVEMENT	136
702.	ROADWAY BASE AND SUBGRADE	136
702-1.	BASE.....	136
702-2.	SUBGRADE	138
703.	ASPHALTIC CONCRETE MATERIALS.....	138
703-1.	ASPHALTIC CONCRETE.....	138
703-2.	HOT BITUMINOUS MIXTURES – PLANT, METHODS, EQUIPMENT & QUALITY ASSURANCE	139
703-3.	ASPHALT MIX DESIGNS AND TYPES.....	139
703-4.	ASPHALT PAVEMENT DESIGNS AND LAYER THICKNESS.....	139
703-5.	GENERAL CONSTRUCTION REQUIREMENTS.....	139
703-6.	CRACKS AND POT HOLE PREPARATION.....	140
703-7.	ADJUSTMENT OF MANHOLES AND APPURTANENCES	140
703-8.	ADDITIONAL ASPHALT REQUIREMENTS	141
703-9.	BASIS OF MEASUREMENT	141
703-10.	BASIS OF PAYMENT	141
704.	ADJUSTMENT TO THE UNIT BID PRICE FOR ASPHALT	142
705.	ASPHALT DRIVEWAYS	142
705-1.	BASIS OF MEASUREMENT	142
705-2.	BASIS OF PAYMENT	142
706.	CONCRETE CURBS	142
706-1.	BASIS OF MEASUREMENT	143
706-2.	BASIS OF PAYMENT	143
707.	CONCRETE SIDEWALKS AND DRIVEWAYS.....	143
707-1.	CONCRETE SIDEWALKS.....	143
707-2.	CONCRETE DRIVEWAYS.....	143
707-3.	CONCRETE CURB RAMPS	144

SECTION IV – Technical Specifications

707-4.	BASIS OF MEASUREMENT	144
707-5.	BASIS OF PAYMENT	144
708.	MILLING OPERATIONS	144
708-1.	EQUIPMENT, CONSTRUCTION & MILLED SURFACE	144
708-2.	ADDITIONAL MILLING REQUIREMENTS	144
708-3.	SALVAGEABLE MATERIALS	145
708-4.	DISPOSABLE MATERIALS	145
708-5.	ADJUSTMENT AND LOCATION OF UNDERGROUND UTILITIES	145
708-6.	ADJUSTMENT OF UTILITY MANHOLES	145
708-7.	TYPES OF MILLING.....	145
708-8.	MILLING OF INTERSECTIONS	146
708-9.	BASIS OF MEASUREMENT	146
708-10.	BASIS OF PAYMENT	146
800 SERIES: TRAFFIC SIGNALS, SIGNS AND MARKINGS		147
801.	TRAFFIC SIGNAL EQUIPMENT AND MATERIALS	147
801-1.	BASIS OF MEASUREMENT AND PAYMENT	147
802.	SIGNING AND MARKING	147
802-1.	BASIS OF MEASUREMENT AND PAYMENT	148
803.	ROADWAY LIGHTING	148
803-1.	BASIS OF MEASUREMENT AND PAYMENT	148
900 SERIES: LANDSCAPING/RESTORATION		149
901.	WORK IN EASEMENTS OR PARKWAYS	149
902.	GENERAL PLANTING SPECIFICATIONS	149
902-1.	IRRIGATION.....	149
902-2.	LANDSCAPE	155
903.	SODDING	165
904.	SEEDING	166
905.	LAWN MAINTENANCE SPECIFICATIONS.....	166
905-1.	SCOPE	166
905-2.	SCHEDULING OF WORK.....	166
905-3.	WORK METHODS	167
906.	LEVEL OF SERVICE	168
907.	COMPLETION OF WORK	169
908.	INSPECTION AND APPROVAL	169
909.	SPECIAL CONDITIONS.....	169
910.	TREE PROTECTION	169
910-1.	TREE BARRICADES.....	169
910-2.	ROOT PRUNING	170
910-3.	PROPER TREE PRUNING	171
911.	IRRIGATION SYSTEM DESIGN.....	171
912.	IRRIGATION SYSTEM INSTALLATION	172

100 SERIES: GENERAL

101. SCOPE OF WORK

Project Name:	NE WRF MCC-1, DC1 & 2 REPLACEMENT
Project Number:	17-0028-UT
Scope of Work:	<p>The creation of a separate Electrical Room within the existing Control Building electrical area. Electrical Room to be air conditioned with a raised “data center” floor capable of supporting the electrical equipment. Room to have mezzanine floor with staircase and double doors.</p> <p>New access door to Blower Room from Control Building electrical area and modifications to existing concrete floor to address subsidence.</p> <p>The replacement and relocation of the 2nd Anoxic Mixer motor control center (MCC-1) and the switchgear distribution centers (DC-1 and DC-2) to be installed in new electrical room. Removal of existing FRP structure with existing MCC-1</p> <p>Project includes a new 1200A Nema 4X Service Entrance Breaker with new Utility transformer connection; new Automatic Transfer Switch, NEMA 12 switchboards, “Smart” MCC, Integral Power Center, panelboards, and Trystar generator load bank tap box, all associated concrete ductbanks, handholes, and cable trays. Project also includes incorporation of “Smart” MCC into existing SCADA system which will require programming services.</p> <p>Existing ATS shall be offered to City for salvage.</p> <p>The Contractor shall provide copies of a current Contractor License/Registration with the state of Florida and Pinellas County in the bid response.</p> <p>The Contractor shall provide 1 fixed project signs as described in Section III, Section 23 of the Contract Documents. The final number of project signs will be determined at the beginning of the project based on the Contractor’s schedule of work submitted for approval. Additional project signs may be required at no additional cost to the city due to the Contractor’s schedule of work.</p>
	Contract Period: <u>635</u> Consecutive Calendar Days

102. FIELD ENGINEERING

102-1. LINE AND GRADE PERFORMED BY THE CONTRACTOR

Unless otherwise specified, the Contractor shall provide and pay for field engineering service required for the project. Such work shall include survey work to establish lines and levels and to locate and lay out site improvements, structures, and controlling lines and levels required for the construction of the work. Also included are such Engineering services as are specified or required to execute the Contractor’s construction methods. Engineers and Surveyors shall be licensed professionals under the laws of the State of Florida. The Contractor shall provide three (3) complete sets of As-Built Surveys to the Engineer prior to final payment being made as outlined in Section III (General Conditions), Section 6.11.2 of these Contract Documents.

102-1.1. GRADES, LINES AND LEVELS

Existing basic horizontal and vertical control points for the project are those designated on the Drawings or provided by the city. Control points (for alignment only) shall be established by the Engineer. The Contractor shall locate and protect control points prior to starting site work and shall preserve all permanent reference points during construction. In working near any permanent property corners or reference markers, the Contractor shall use care not to remove or disturb any such markers. In the event that markers must be removed or are disturbed due to the proximity of construction work, the Contractor shall have them referenced and reset by a Professional Land Surveyor licensed in the State of Florida.

102-1.2. LAYOUT DATA

The Contractor shall layout the work at the location and to the lines and grades shown on the Drawings. Survey notes indicating the information and measurements used in establishing locations and grades shall be kept in notebooks and furnished to the Engineer with the record drawings for the project.

102-2. LINE AND GRADE PERFORMED BY THE CITY

If line and grade is supplied by the city, at the completion of all work the Contractor shall be responsible to have furnished to the project inspector a replacement of the wooden lath and stakes used in the construction of this project. Excessive stake replacement caused by negligence of Contractor's forces, after initial line and grade have been set, as determined by the City Engineer, will be charged to the Contractor at the rate of \$200.00 per hour. Time shall be computed for actual time on the project. All time shall be computed in one-hour increments. Minimum charge is \$200.00. The Contractor shall provide three (3) complete sets of As-built Surveys to the Engineer prior to final payment being made as outlined in Section III (General Conditions), Section 6.11.2 of these Contract Documents.

103. DEFINITION OF TERMS

For the Purpose of these Technical Specifications, the Definition of Terms from *Section III, Article 1 – Definitions* of these Contract Documents shall apply.

For the purpose of the Estimated Quantities, the Contractor's attention is called to the fact that the estimate of quantities as shown on the Proposal is approximate and is given only as a basis of calculation upon which the award of the contract is to be made. The city does not assume any responsibility that the final quantities will remain in strict accordance with estimated quantities nor shall the Contractor plead misunderstandings or deception because of such estimate of quantities or of the character or location of the work or of other conditions or situations pertaining thereto.

The basis of payment for work and materials will be the actual amount of work done and materials furnished. Contractor agrees that they will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work performed and materials actually furnished and the estimated amounts thereof.

103-1. REFERENCE STANDARDS

Reference to the standards of any technical society, organization, or associate, or to codes of local or state authorities, shall mean the latest standard, code, specification, or tentative standard adopted and published at the date of receipt of bids, unless specifically stated otherwise.

The most stringent specification prevails in the case where more than one specification is referenced for the same task.

Contractor shall utilize applicable Florida Department of Transportation (FDOT) Standards and Specifications for tasks that are not covered by city's Standards and Specifications.

104. STREET CROSSINGS, ETC.

At such crossings, and other points as may be directed by the Engineer, trenches shall be bridged in an open and secure manner, so as to prevent any serious interruption of travel upon the roadway or sidewalk, and also to afford necessary access to public or private premises. The material used, and the mode of constructing said bridges, and the approaches, thereto, must be satisfactory to the Engineer.

The cost of all such work must be included in the cost of the trench excavation.

105. AUDIO/VIDEO RECORDING OF WORK AREAS

105-1. CONTRACTOR TO PREPARE AUDIO/VIDEO RECORDING

Prior to commencing work, the Contractor shall have a continuous color audio/video recording taken along the entire length of the Project including all affected project areas. Streets, easements, rights-of-way, lots or construction sites within the Project must be recorded to serve as a record of pre-construction conditions.

105-2. SCHEDULING OF AUDIO/VIDEO RECORDING

The video recordings shall not be made more than twenty-one (21) days prior to construction in any area.

105-3. PROFESSIONAL VIDEOGRAPHERS

The Contractor shall engage the services of a professional videographer. The color audio/video recording shall be prepared by a responsible commercial firm known to be skilled and regularly engaged in the business of pre-construction color audio/video recording documentation. Use of drones must be in accordance with Federal Aviation Administration (FAA) regulations.

105-4. EQUIPMENT

All equipment, accessories, materials, and labor to perform this service shall be furnished by the Contractor. The total audio/video system shall reproduce bright, sharp, clear pictures with accurate colors and shall be free from distortion, tearing, rolls or any other form of imperfection. The audio portion of the recording shall reproduce the commentary of the camera operator with proper volume, clarity and be free from distortion and interruptions. In some instances, audio/video coverage may be required in areas not accessible by conventional wheeled vehicles. Such coverage shall be obtained by walking.

105-5. RECORDED AUDIO INFORMATION

Each recording shall begin with the current date, project name and be followed by the general location, i.e., viewing side and direction of progress. Accompanying the video recording of each video shall be a corresponding and simultaneously recorded audio recording. This audio recording, exclusively containing the commentary of the camera operator or aide, shall assist in viewer orientation and in any needed identification, differentiation, clarification, or objective description of the features being shown in the video portion of the recording. The audio recording shall also be free from any conversations.

105-6. RECORDED VIDEO INFORMATION

All video recordings must continuously display transparent digital information to include the date and time of recording. The date information shall contain the month, day, and year. The time information shall contain the hour, minutes, and seconds. Additional information shall be displayed periodically. Such information shall include, but not be limited to, project name, contract number, direction of travel and the viewing side. This transparent information shall appear on the extreme upper left hand third of the screen. Camera pan, tilt, zoom-in and zoom out rates shall be sufficiently controlled such that recorded objects will be clearly viewed during video playback. In addition, all other camera and recording system controls, such as lens focus and aperture, video level, pedestal, chrome, white balance, and electrical focus shall be properly controlled or adjusted to maximize picture quality.

105-7. VIEWER ORIENTATION

The audio and video portions of the recording shall maintain viewer orientation. To this end, overall establishing views of all visible house and business addresses shall be utilized. In areas where the proposed construction location will not be readily apparent to the video viewer, highly visible yellow flags shall be placed by the Contractor in such a fashion as to clearly indicate the proposed centerline of construction. When conventional wheeled vehicles are used as conveyances for the recording system, the vertical distance between the camera lens and the ground shall not exceed ten feet (10'). The camera shall be firmly mounted such that transport of the camera during the recording process will not cause an unsteady picture.

105-8. LIGHTING

All recording shall be done during time of good visibility. No videoing shall be done during precipitation, mist, or fog. The recording shall only be done when sufficient light is present to properly illuminate the subjects of recording and to produce bright, sharp video recordings of those subjects.

105-9. SPEED OF TRAVEL

The average rate of travel during a particular segment of coverage shall be directly proportional to the number, size, and value of the surface features within the construction area's zone of influence. The rate of speed in the general direction of travel used during videoing shall not exceed forty-four (44) feet per minute.

105-10. VIDEO LOG/INDEX

All videos shall be permanently labeled and shall be properly identified by video number and project title. Each video shall have a log of that video's contents. The log shall describe the various segments of coverage contained on the video in terms of the names of the streets or location of easements, coverage beginning and end, directions of coverage, video unit counter numbers, engineering survey or coordinate values (if reasonably available) and the date.

105-11. AREA OF COVERAGE

Video coverage shall include all surface features located within the zone of influence of construction supported by appropriate audio coverage. Such coverage shall include, but not be limited to, existing driveways, sidewalks, curbs, pavements, drainage system features, mailboxes, landscaping, culverts, fences, signs, Contractor staging areas, adjacent structures, etc., within the area covered by the project. Of particular concern shall be the existence of any faults, fractures, or defects. Taped coverage shall be limited to one side of the Site, street, easement or right of way at any one time.

105-12. COSTS OF VIDEO SERVICES

The cost to complete the requirements under this section shall be included in the contract items provided in the proposal sheet. There is no separate pay item for this work.

106. STREET SIGNS

The removal, covering or relocation of street signs by the Contractor is prohibited.

All street signs shall be removed, covered, or relocated by the city's Traffic Engineering Division in accordance with Sections 700, 994, 995, and 996 of FDOT's Standard Specifications.

The Contractor shall notify the city's Traffic Engineering Division a minimum of twenty-four (24) hours in advance of the proposed sign relocation, covering or removal.

107. WORK ZONE TRAFFIC CONTROL

107-1. CONTRACTOR RESPONSIBLE FOR WORK ZONE TRAFFIC CONTROL

The Contractor shall be responsible to furnish, operate, maintain and remove all work zone traffic control associated with the Project, including detours, advance warnings, channelization, hazard warnings and any other necessary features, both at the immediate work site and as may be necessary at outlying points.

107-2. WORK ZONE TRAFFIC CONTROL PLAN

The Contractor shall prepare a detailed traffic control plan designed to accomplish the level of performance outlined in the Scope of the Work and/or as may be required by construction permits issued by Pinellas County and/or the FDOT for the Project, incorporating the methods and criteria contained in Part VI, Standards and Guides for Traffic Controls for Street and Highway Construction, Maintenance, Utility and Incident Management Operations in the Manual on Uniform Traffic Control Devices published by the U.S. Department of Transportation and adopted as amended by the Florida Department of Transportation, or most recent addition. This plan shall be reviewed and approved by city Engineering Department Traffic Operations personnel regardless if Maintenance of Traffic (MOT) plan details are included in the contract plans.

107-2.1. WORK ZONE SAFETY

The general objectives of a program of work zone safety are to protect workers, pedestrians, bicyclists and motorists during construction and maintenance operations. This general objective may be achieved by meeting the following specific objectives:

- Provide adequate advance warning and information regarding upcoming work zones.
- Provide the driver clear directions to understanding the situation they will be facing as the driver proceeds through or around the work zone.
- Reduce the consequences of an out of control vehicle.
- Provide safe access and storage for equipment and material.
- Promote speedy completion of projects (including thorough cleanup of the site).
- Promote use of the appropriate traffic control and protection devices.
- Provide safe passageways for pedestrians through, in, and/or around construction or maintenance work zones.

“When an existing pedestrian way or bicycle way is located within a traffic control work zone, accommodation must be maintained and provision for the disabled must be provided. Only approved pedestrian longitudinal channelizing devices may be used to delineate a temporary traffic control zone pedestrian walkway. Advanced notification of sidewalk closures and marked detours shall be provided by appropriate signs.” Per the 2014 FDOT Standard Specifications for Road and Bridge Construction or latest revision.

FDOT Design Standards (DS): 102-5 Traffic Control, 102-5.1 Standards, are the minimum standards for the use in the development of all traffic control plans (use the latest edition).

All traffic control plans must be submitted to the city Engineering Department, Traffic Operations Division for review and approval prior to installation. Contractor shall also provide notification to city Engineering, Traffic Operations Division a minimum of 72-hours in advance of mobilization. Approved MOT must always be on site and accessible to the city Project Manager and/ or Representative.

107-3. ROADWAY CLOSURE GUIDELINES

Roadway types: Major Arterials, Minor Arterials, Local Collectors, and Local

Following are typical requirements to be accomplished prior to closure. The number of requirements increases with traffic volume and the importance of access. Road closures affecting business or sole access routes will increase in process requirements as appropriate. For all but local streets, no road or lane closures are allowed without prior approval by the City Engineer or designated Representative (Engineering Traffic Operations Manager).

107-3.1. ALL ROADWAYS

Obtain permits for Pinellas County or Florida Department of Transportation roadways.

Traffic control devices conform to national and state standards.

107-3.1.1. PUBLIC NOTIFICATION

Standard property owner notification prior to start of construction for properties directly affected by the construction process.

107-3.2. MAJOR ARTERIALS, MINOR ARTERIALS, LOCAL COLLECTORS

Consult with city Engineering Traffic Operations Division staff for preliminary traffic control options.

Develop Formal Traffic Control Plan for Permit Submittal to Regulatory Agency as necessary.

107-3.2.1. PUBLIC NOTIFICATION

Message Board Display, Minimum of seven (7) day notice period prior to road closure and potentially longer for larger highway. The message board is to be provided by the Contractor.

107-3.3. MAJOR ARTERIALS, MINOR ARTERIALS

107-3.3.1. PUBLIC NOTIFICATION

Releases can be issued as PowerPoint Presentation for C-View System utilizing television monitors.

107-3.4. MAJOR ARTERIALS

107-3.4.1. PUBLIC NOTIFICATION

News Releases shall be issued by the city Public Communication Department. The Message Board may need to be displayed for a period longer than seven (7) days.

107-4. APPROVAL OF WORK ZONE TRAFFIC CONTROL PLAN

The Contractor is invited and encouraged to confer in advance of bidding, and is required, as a specification of the work, to confer in advance of beginning any work on the Project, with the Traffic Operations Division, Municipal Services Building, 100 South Myrtle Avenue, telephone (727) 562-4747, for the purpose of approval of the Contractor's proposed detailed traffic control plan. All maintenance of traffic (MOT) plans shall be signed and sealed by a Professional Engineer or an individual who is certified in the preparation of MOT plans in the State of Florida. Contractor is required to submit the MOT preparer's accreditation along with the plan submittal.

107-5. INSPECTION OF WORK ZONE TRAFFIC CONTROL OPERATION

The city Engineering Traffic Operations Division may inspect and monitor the traffic control plan and traffic control devices of the Contractor. The city's Construction Inspector assigned to the project may make known requirements for any alterations or adjustments to the traffic control devices. The Contractor shall take direction from the city representative.

107-6. PAYMENT FOR WORK ZONE TRAFFIC CONTROL

Payment for work zone traffic control is a non-specific pay item to be included in the construction costs associated with other specific pay items unless specifically stated otherwise.

107-7. CERTIFICATION OF WORK ZONE TRAFFIC CONTROL SUPERVISOR

The city may require that the Supervisor or Foreman controlling the work for the Contractor on the Project have a current International Municipal Signal Association, Work Zone Traffic Control Safety Certification or Worksite Traffic Supervisor Certification from the American Traffic Safety Association with additional current Certification from the Florida Department of Transportation. This requirement for Certification will be noted in the Scope of Work and/or sections of these Technical Specifications. When the certified supervisor is required for the Project, the supervisor will be on the Project site at all times while work is being conducted.

The Worksite Traffic Supervisor shall be available on a twenty-four (24) hour per day basis and shall review the project on a day-to-day basis as well as being involved in all changes to traffic control. The Worksite Traffic Supervisor shall have access to all equipment and materials needed to maintain traffic control and handle traffic related situations. The Worksite Traffic Supervisor shall ensure that routine deficiencies are corrected within a twenty-four (24) hour period.

The Worksite Traffic Supervisor shall be available on the site within 45 minutes after notification of an emergency situation, prepared to positively respond to repair the work zone traffic control or to provide alternate traffic arrangements.

Failure of the Worksite Traffic Supervisor to comply with the provisions of this sub section may be grounds for decertification or removal from the project or both. Failure to maintain a designated Worksite Traffic Supervisor or failure to comply with these provisions will result in temporary suspension of all activities except traffic and erosion control and such other activities deemed to be necessary for project maintenance and safety.

108. OVERHEAD ELECTRIC LINE CLEARANCE

108-1. CLEARANCE OPTIONS

When working in the vicinity of overhead power lines, the Contractor shall utilize one of the following options:

- Option 1: Having the power lines de-energized and visibly grounded.
- Option 2: Maintaining a minimum distance of twenty feet (20') of clearance for voltages up to 350 kV and fifty feet (50') of clearance for voltages more than 350 kV.
- Option 3: Determine the line voltage and provide clearance in accordance with the following table.

108-2. REQUIRED MINIMUM CLEARANCE DISTANCES

VOLTAGE [nominal, kV, alternating current]	MINIMUM CLEARANCE DISTANCE [feet]
Up to 50	10
Over 50 to 200	15
Over 200 to 350	20
Over 350 to 500	25
Over 500 to 750	35
Over 750 to 1,000	45
Over 1,000	(as established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electric power transmission and distribution)

Note: The value that follows “to” is up to and includes that value. For example, over 50 to 200 means up to and including 200kV.

The equipment supplied and installed shall meet the requirements of the National Electric Code and all applicable local codes and regulations

200 SERIES: SITWORK

201. EXCAVATION FOR UNDERGROUND INFRASTRUCTURE WORK

The Contractor is responsible to take all necessary steps to conduct all excavation in a manner which provides for the successful completion of the proposed work while at all times maintaining the safety of the workmen, the general public and both public and private property. The Contractor's methods of work will be consistent with the standard practices and requirements of all appropriate Safety Regulatory Agencies, particularly the Occupational Safety and Health Administration (OSHA) requirements for excavation. Unless otherwise specifically stated in these plans and specifications, the methods of safety control and compliance with regulatory agency safety requirements are the full and complete responsibility of the Contractor.

For the purposes of the Contractor's safety planning in the bidding process, the Contractor is to consider all excavation to be done in the performance of this contract to be in soil classified as OSHA "Type C". The Contractor's attention is called to specific requirements of OSHA for excavation shoring, employee entry, location of excavated material adjacent to excavation, the removal of water from the excavation, surface encumbrances and in particular the requirement of a "Competent Person" to control safety operations. The Contractor shall submit to the city if requested prior to the start of work a safety plan for the excavation and work activities. The Contractor will identify their Competent Person to city staff at the start of construction. Clearwater Fire Dept. requires a Trench Permit and site inspection for any depths greater than five feet (5') and any excavation that exceeds twenty feet (20') shall require the submittal of a trench shoring plan prepared by a Professional Engineer actively licensed in the State of Florida.

City staff is required from time to time to perform inspections, tests, survey location work, or other similar activity in an excavation prepared by the Contractor. City staff, in conformance with the OSHA Excavation Safety Requirements, is to only enter an excavation in compliance with these OSHA standards. The city's staff reserve the option to refuse entry into the Contractor's excavation if, in the opinion of the city's staff, the entry into the Contractor's excavation is unsafe or does not conform to OSHA requirements. If this circumstance occurs, the Contractor must either provide the necessary safety requirements or provide alternate means for the accomplishment of the city's work at the Contractor's expense.

The construction quantities, if any, contained in the bid proposal for this contract do not contain sufficient quantities to allow the Contractor to perform excavation work using strictly the "open cut" method whereby no shoring systems are used and trench side slopes are cut to conform to OSHA safety requirements without a shoring system. In addition to safety reasons, the Contractor is required to use excavation and trench-shoring methods in compliance with all safety requirements which allow the Contractor to control the amount of restoration work necessary to complete the project.

Not more than four hundred feet (400') of trench shall be opened at one time in advance of the completed work unless written permission is received from the city and/or the Engineer for the distance specified. For pipe installation projects, the trench shall be a minimum of six inches (6") wider on each side than the greatest external horizontal width of the pipe or conduit, including hubs, intended to be laid in them. The bottom of the trench under each pipe joint shall be slightly hollowed, to allow the body of the pipe to rest throughout its length. In case a trench is excavated at any place, except at joints, below the grade of its bottom as given, or directed by the Engineer, the filling and compaction to grade shall be done in such manner as the Engineer shall direct, without additional compensation.

201-1. EXCAVATION, BACKFILLING, AND COMPACTION FOR UNDERGROUND INFRASTRUCTURE

201-1.1. GENERAL

Scope of Work: The work included under this Section consists of dewatering, excavating, trenching, sheeting/shoring, grading, backfilling, and compacting those soil materials required for the construction of the structures, piping, ditches, utility structures and appurtenances as shown on the Drawings and specified herein.

Definitions:

- A. **Maximum Density:** Maximum weight in pounds per cubic foot of a specific material as determined by ASTM D1557.
- B. **Optimum Moisture Content:** The optimum moisture content shall be determined by ASTM D 1557 specified to determine the maximum dry density for relative compaction. Field moisture content shall be determined on the basis of the fraction passing the 3/4-inch sieve.
- C. **Rock Excavation:** Excavation of any hard-natural substance which requires the use of special impact tools such as jack hammers, sledges, chisels, or similar devices specifically designed for use in cutting or breaking rock, but exclusive of trench excavating machinery.
- D. **Suitable Soil Materials:** Suitable materials for fills shall be a non-cohesive, non-plastic granular local sand and shall be free from vegetation, organic material, marl, silt or muck and shall be classified as A-1, A-3 or A-2-4 in accordance with AASHTO Designation M-145. Not more than 10 percent (%) by weight of fill material shall pass the No. 200 Sieve. The Contractor shall furnish all additional fill material required.
- E. **Unsuitable Soil Materials:** Unsuitable materials are classified as A-2-5, A-2-6, A-2-7, A-4, A-5, A-6, A-7, and A-8 in accordance with AASHTO Designation M-145.

Plan for Earthwork:

- A. The Contractor shall be responsible for having determined to his satisfaction, prior to the submission of his bid, the conformation of the ground, the character and quality of the substrata, the types and quantities of materials to be encountered, the nature of the groundwater conditions, the prosecution of the work, the general and local conditions and all other matters which can in any way affect the work under this Contract according to the General Conditions.
- B. Prior to commencing the excavation, the Contractor shall submit a plan of his proposed operations, including maintenance of traffic, to the Engineer and the city for review and approval. The Contractor shall consider, and his plan for excavation shall reflect, the equipment and methods to be employed in the excavation. The prices established in the Proposal for the work to be done will reflect all costs pertaining to the work. No claims for extras based on substrata or groundwater table conditions shall be allowed.

Trench Safety:

- A. All trench excavations which exceed 5 feet in depth shall comply at all times with the applicable trench safety standards as stated in the OSHA excavation safety standards 29 CFR S. 1926.650 Subpart P as regulated and administered by the Florida Department of Labor and Employment Security as the "Florida Trench Safety Act".
- B. The Contractor shall comply with all of the requirements of the Florida Trench Safety Act. The Contractor shall acknowledge that included in various items of his bid proposal and in the total bid price are costs for complying with the provisions of the Act.

Testing: A Certified Testing Laboratory employed by the Contractor shall make such tests as are required to demonstrate compliance with these specifications. The Contractor shall schedule his work to permit a

reasonable time for testing before placing succeeding lifts and shall keep the laboratory informed of his progress. All costs for all testing shall be paid by the Contractor.

Changed Job Conditions: If, in the opinion of the Engineer or the city Representative, conditions encountered during construction warrant a change in the structure footing elevation, or in the depth of removal of unsuitable material from that indicated in the soils report, an adjustment will be made in the contract price as provided in the General and Special Conditions.

Utility Construction Surveys:

- A. Prior to commencing excavation, backfill or dewatering for utilities, the Contractor shall conduct a survey of those existing structures which, in the opinion of the Engineer, may be subject to settlement or distress resulting from excavation or dewatering operations.
- B. The Contractor shall monitor the structures surveyed to ascertain evidence of settlement or distress during construction. If settlement or distress becomes evident, the Contractor shall be required to repair the structures to the previous condition to the satisfaction of the Engineer and the city. All costs for repairs shall be paid by the Contractor.

Submittals:

- A. Submit to the Engineer for review the proposed methods of construction, including dewatering, excavation, bedding, filling, compaction, and backfilling for the various portions of the work. Review shall be for method only. The Contractor shall remain responsible for the adequacy and safety of the methods.
- B. Submit to the Engineer for review and approval the sieve analyses and soil classifications completed by the Geotechnical Engineer hired by the Contractor, for materials to be used for pipe bedding and trench and structural backfill including Structural Fill, Class I and Class II soil materials, Crushed Stone bedding materials and Coarse Sand materials.
- C. Submit to the Engineer for review, the soil compaction results

201-1.2. mATERIALS

General Requirements:

- A. All fill materials from on and off-site sources shall be subject to the approval of the Engineer and the city.
- B. All fill material shall be unfrozen and free of organic material, trash, or other objectionable material. Excess or unsuitable material as designated by the Engineer shall be removed from the job site by the Contractor.

Common Fill Materials:

- A. Common fill shall be sand, free of clay, organic material, muck, loam, wood, trash and other objectionable material which may be compressible, or which cannot be compacted properly. It shall not contain stones, rock, concrete or other rubble larger than 1-1/2-inches in diameter. It shall have physical properties which allow it to be easily spread and compacted.
- B. Common fill shall be no more than 10 percent by weight finer than the No. 200 mesh sieve.
- C. The Contractor shall utilize as much excavated material as possible for reuse as backfill material in accordance with the Contract Drawings and Project Specifications or as directed by the Engineer.
- D. The Engineer shall direct the Contractor on the type of material allowed in certain sections of the earthwork operations.

Structural Fill:

Structural fill shall be well graded sand to gravel-sand having the following gradation:

U.S. Sieve Size	Percent Passing by Weight
1-inch	100%
No. 4 Sieve	75% to 100%
No. 40 Sieve	15% to 80%
No. 100 Sieve	0 to 30%
No. 200 Sieve	0 to 10%

Class I Soils*:

Manufactured angular, granular material, 1/4-inch to 1-1/2- inches in size, including materials having significance such as crushed stone or rock, broken coral, crushed slag, cinders, or crushed shells. Sieve analysis for crushed stone is given below separately.

- A. Crushed Stone: Crushed stone shall consist of clean mineral aggregate free from clay, loam or organic matter conforming with particle size limits as included in *Table 201-A* below. Unless approved otherwise by the engineer, crushed stone for PVC, FRP or HDPE pipe bedding shall conform with ASTM C33 stone size No. 89 and crushed stone for ductile iron pipe shall conform to ASTM C33 stone size No. 68 or 78.

* Soils defined as Class I soils are not defined in ASTM D2487.

Class II Soils:**

- A. GW: Well-graded gravels and gravel-sand mixtures, little or no fines, clean. Fifty (50) percent or more retained on No. 4 sieve. More than 95 percent retained on No. 200 sieve.
- B. GP: Poorly graded gravels and gravel-sand mixtures, little or no fines, clean. Fifty (50) percent or more retained on No. 4 sieve. More than 95 percent retained on No. 200 sieve.
- C. SW: Well-graded sands and gravelly sands, little or no fines, clean. More than fifty (50) percent passing No. 4 sieve. More than 95 percent retained on No. 200 sieve.
- D. SP: Poorly graded sands and gravelly sands, little or no fines, clean. More than fifty (50) percent passing No. 4 sieve. More than 95 percent retained on No. 200 sieve.

** In accordance with ASTM D2487, less than 5 percent passing No. 200 sieve.

Coarse Sand:

Sand shall consist of clean mineral aggregate with particle size limits as follows:

U.S. Sieve Size	Percent Passing By Weight
No. 10 Sieve	100%
No. 20 Sieve	0 to 30%
No. 40 Sieve	0 to 5%

Other Material:

All other material, not specifically described, but required for proper completion of the work shall be selected by the Contractor and approved by the Engineer.

201-1.3. cLEARING AND gRUBBING**201-1.3.1. GENERAL**

- A. Clearing: Clearing shall completely remove and dispose of all timber, shrubs, brush, stumps, limbs, roots, grass, weeds, other vegetative growth, rubbish and all other objectionable obstructions resting on or protruding through the surface of the ground. Remove all evidence of their presence from the surface including sticks and branches. Remove and dispose of trash piles and rubbish that is scattered over the construction site or collects there during construction. Those trees, shrubs, vegetative growth, and fencing, if any, which are designed by the Engineer to remain, shall be

preserved and protected as hereinafter specified. Clearing operations shall be conducted so as to prevent damage to existing structures and installations and to those under construction, so as to provide for safety of employees and others.

- B. Grubbing: Grubbing shall consist of the complete removal of all stumps, roots larger than 1-1/2 inches in diameter, matted roots, brush, timber, logs, and any other organic or metallic debris remaining after clearing not suitable for foundation purposes, resting on, under or protruding through the surface of the ground to a depth of 18-inches below the subgrade or the bottom of utility trenches. All depressions excavated below the original ground surface for or by the removal of such objects, shall be refilled with suitable materials and compacted to a density conforming to the surrounding ground surface.
- C. Stripping: Remove and dispose of all organics and sod, topsoil, grass, and grass roots, and other objectionable material remaining after clearing and grubbing from the areas designated to be stripped. Grass, grass roots and organic material in areas to be excavated or filled shall be stripped to the depth as noted in the soils report. In areas so designated, topsoil shall be stockpiled. Stripped material and unsuitable material, such as organic material, shall be disposed of by the Contractor unless directed otherwise by the Engineer.
 - 1. In areas so designated, topsoil shall be stripped and stockpiled. Topsoil so stockpiled shall be protected until it is placed as specified. Any topsoil remaining after all work is in place shall be disposed of by the Contractor.

201-1.3.2. CLEARING AND GRUBBING OPERATIONS

Clearing and Grubbing Limits: All excavation areas associated with new structures, slabs, utilities and roadways shall be cleared and grubbed to the following depths:

- A. Proposed Structures: 2-feet below existing grade within a 5-foot margin of each structure and replaced with compacted structural fill material as specified in *Section 201-2.2*
- B. Building Site Areas not specifically noted above: 2-feet below existing grade within a 5-foot margin of each building site area and replaced with compacted structural fill material as specified in *Section 201-2.2*.
- C. Utility Trenches: 1.5-feet below the bottom of the utility trench within the entire width of the trench and replaced with compacted Class II Soils, Type SW or SP material as specified in *Section 201-2.2*.
- D. Roadway and Paved Area: 2-feet below existing grade within a 5-foot margin of areas paved and replaced with compacted common fill material as specified.
- E. All Other Areas: 1-foot below completed surface and replaced with compacted common fill material as specified.

Areas to be Stripped: All excavation and embankment areas associated with new structures, slabs, walks, and roadways shall be stripped. Stockpile areas shall be stripped.

201-1.3.3. DISPOSAL OF DEBRIS MATERIAL

- A. Disposal of Clearing and Grubbing Debris: The Contractor shall dispose of all material and debris from the clearing and grubbing operations by hauling such material and debris away to an approved disposal site and dispose of in accordance with all local laws, codes, and ordinances. Disposal by burning or burial on-site shall not be permitted. The cost of disposal (including hauling) of cleared and grubbed material and debris shall be considered a subsidiary obligation of the Contractor, the cost of which shall be included in the contract price.
- B. Disposal of Stripped Material: Remove all stripped material and dispose off-site in a legal manner, unless otherwise directed by the Engineer to stockpile the material, such as topsoil, for use in the final Work.

201-1.3.4. PRESERVATION OF TREES AND SHRUBBERY

- A. Trees and Shrubbery: All existing trees, shrubbery, and other vegetative material may not be shown on the Drawings. Inspect the site as to the nature, location, size, and extent of vegetative material to be removed or preserved, as specified herein. Preserve, in place, trees that are specifically shown on the Drawings and designated to be preserved.
- B. Tree Protection: Those trees which are designated for preservation shall be carefully protected from damage. The Contractor shall erect such barricades, guards, and enclosures as may be considered necessary for the protection of the trees during all construction operations.
- C. Preservation and Protection of Trees, Shrubs, and Other Plant Material:
 - 1. All plant materials (trees, shrubbery, and plants) beyond the limits of clearing and grubbing shall be saved and protected from damage resulting from the work. No filling, excavating, trenching, or stockpiling of materials will be permitted within the drip line of these trees or plants. The drip line is defined as a circle drawn by extending a line vertically to the ground from the outermost branches of a tree, plant, or group of plants. To prevent soil compaction within the drip line area, no equipment will be permitted within this area.
 - 2. When trees are close together, restrict entry to area within drip line by fencing or a protective barrier. In areas where no fence or barrier is erected, the trunks of all trees 2-inches or greater in caliper shall be protected by encircling the trunk entirely with boards held securely by 10-gauge wire and staples. This protection shall extend from ground level to a height of 6-feet. Neatly cut and remove tree branches where such cutting is necessary to affect construction operations. The cutting and removing must be performed or supervised by an I.S.A certified arborist. Remove branches other than those required to affect the work to provide a balanced appearance of any tree. Scars resulting from the removal of branches shall be treated with a tree sealant.

201-1.3.5. PRESERVATION OF DEVELOPED PRIVATE PROPERTY

- A. The Contractor shall exercise extreme care to avoid unnecessary disturbance of developed private property. Trees, shrubbery, gardens, lawns, and other landscaping, which in the opinion of the Engineer must be removed, shall be replaced and replanted to restore the construction easement to the condition existing prior to construction.
- B. All soil preparation procedures and replanting operations shall be under the supervision of a nurseryman experienced in such operations.
- C. Improvements to the land such as fences, walls, outbuildings, etc., which of the necessity of construction activities must be removed, shall be replaced with equal quality materials and workmanship.
- D. The Contractor shall clean up the construction site across from developed private property directly after construction is completed upon approval of the Engineer.

201-1.3.6. PRESERVATION OF PUBLIC PROPERTY

The appropriate paragraphs of *Sections 203-2.3.4. and 203-2.3.5.* of these specifications shall apply to the preservation and restoration of all damaged areas of public lands, parks, rights-of-way, easements, etc.

201-1.4. EXCAVATION PROTECTION

201-1.4.1. SHEETING AND BRACING

- A. Furnish, put in place, and maintain such sheeting and bracing as required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent utilities or structures, other aboveground structures, utility poles, etc. from being undermined, and to protect workers from

hazardous conditions or other damage. Such support shall consist of braced steel sheet piling, braced wood lagging and soldier piles and beams or other approved methods. If the Engineer or the city is of the opinion that at any points, sufficient or proper supports have not been provided, they may order additional supports to be put in place at the expense of the Contractor, and compliance with such order shall not relieve or release the Contractor from his responsibility for the sufficiency of such supports. Care shall be taken to prevent voids from occurring adjacent to the sheeting, but if voids are formed, they shall be immediately filled and compacted. Where soil cannot be properly compacted to fill a void, lean concrete shall be used as backfill, at no additional expense to the city.

- B. The Contractor shall construct the sheeting outside the neat lines of the foundation unless deemed otherwise for the Contractor's method of operation. Sheeting shall be plumb and securely braced and tied in position. Sheeting and bracing shall be adequate to withstand all pressure to which the structure or trench shall be subjected. Any deformation, movement or bulging which may occur, shall be corrected by the Contractor at his own expense, to provide the necessary clearances and dimensions.
- C. Where sheeting and bracing is required to support the sides of excavations for utility structures, other structures, power poles, etc., the Contractor shall engage a Professional Geotechnical Engineer, registered in the state of Florida, to design the sheeting and bracing. The sheeting and bracing installed shall conform to the design, and certification of the installation shall be provided by the Professional Geotechnical Engineer.
- D. The installation of sheeting, particularly by driving or vibrating, may cause distress to existing structures. The Contractor shall evaluate the potential for such distress and, if necessary, take all precautions to prevent distress of existing structures because of sheeting installation.
- E. The Contractor shall leave in place to be embedded in the backfill all sheeting and bracing not shown on the Drawings but which the Engineer or the city may direct him in writing to leave in place at any time during the progress of the work for the purpose of preventing injury to any structures or property, whether public or private. The Engineer or the city may direct that timber or steel sheeting used for sheeting and bracing be cut off at any specified elevation.
- F. The right of the Engineer or the city to order sheeting and bracing to be left in place shall not be construed as creating any obligation on their part to issue such orders, and their failure to exercise their right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.
- G. Steel or wood sheeting installed for utility pipeline construction shall not, under any circumstances be withdrawn, if driven below the top of any utility pipeline. Steel sheeting, soldier piles and wood sheeting earth support systems installed for utility pipeline construction shall be cut-off and left-in-place at least 3-feet below the ground surface, but no lower than 2-feet above the top of the utility pipe.
- H. All sheeting and bracing not left in place shall be carefully removed in such manner as not to endanger the new construction or other structures, utilities, or property outside the construction area. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by compacting with tools specifically adapted to that purpose, or otherwise as may be directed by the Engineer or the city.

201-1.5. EXCAVATING FOR UTILITY STRUCTURES

Excavation work shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

Excavation shall be made to such dimensions as will give suitable room for building the foundations and the structures, for bracing and supporting, for pumping and draining, for installing the pipelines, and for all other work required.

- A. Excavation for precast or prefabricated structures shall be carried to an elevation two (2) feet lower than the proposed outside bottom of the structure to provide space for the backfill and bedding material.
- B. Excavation for structures constructed or cast-in-place in dewatered or dry excavations shall be carried down to the 2-feet below the bottom of the structure where dewatering methods are such that a dry excavation bottom is exposed and the naturally occurring material at this elevation leveled and left ready to receive construction. Material disturbed below the founding elevation in dewatered excavations shall be replaced with Class B concrete.

Prior to backfilling, document the location, elevation, size, material type and function of all new subsurface installations, and utilities encountered during excavation and construction. Excavation equipment operators and other concerned parties shall be familiar with subsurface obstructions as shown on the Drawings and should anticipate the encounter of unknown obstructions during the work.

Encounters with subsurface obstructions shall be hand excavated.

Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. Subgrade soils which become soft, loose, "quick" or otherwise unsatisfactory for support of structures as a result of inadequate dewatering or caused by other construction methods, shall be removed and replaced with crushed stone as required by the Engineer at the Contractor's expense.

The bottom of excavations shall be rendered firm and dry before placing any structure or pipe. Excavated material not suitable for backfill shall be removed from the site and disposed of by the Contractor, in a legal manner. The bedding schedule for pipes shall be as shown in *Table 201-C*.

If the sub-grade is unsuitable, the Contractor shall, remove and replace all unsuitable material below pipe with selected common fill or bedding rock, compacted to 95 percent Modified Proctor density.

All pavements and sidewalks shall be cut prior to removal, with saws or accepted power tools.

Excavated material shall be stockpiled in such a manner as to prevent nuisance conditions. Surface drainage shall not be hindered.

All structure and pipe locations and elevations as required herein must be permanently documented by the Contractor, on the As-Builts, prior to the Engineer's approval of the Application for Payment for that work.

201-1.6. TRENCH EXCAVATION FOR UTILITY PIPELINES

201-1.6.1. TRENCH EXCAVATION FOR PIPE LAYING - GENERAL

- A. The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. Four hundred (400) feet shall be the maximum length of open trench for any pipeline under construction. All trench excavation shall be open cut from the surface.
- B. Alignment, Grade, and Minimum Cover: The alignment and grade or elevation of each pipeline shall be fixed and determined from offset stakes. Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith shall be in conformance with the requirements of *Section 500* covering installation of pipe.
- C. Where pipe grades or elevations are not definitely fixed by the Contract Drawings, trenches shall be excavated to a depth sufficient to provide a depth of backfill cover over the top of the pipe of Between the range of 30- 42-inches. Greater pipe cover depths may be necessary on vertical curves or to provide necessary clearance beneath existing pipes conduits, drains, drainage structures, or

other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation.

201-1.6.2. LIMITED TRENCH WIDTHS

- A. Trenches shall be excavated to a width which shall provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment. However, minimum permissible sidewall clearances between the installed pipe and each trench wall, expressed in inches, shall be as follows:

Nominal Pipe Size, in Inches	Nominal Sidewall Clearance, in Inches
60	24
54	21
48	19
36 or smaller	12

- B. Stipulated minimum sidewall clearances are not minimum average clearances but are minimum clear distances which shall be required.
- C. Cutting trench banks on slopes to reduce earth load to prevent sliding and caving will be permitted only in areas where the increased trench width will not interface with surface features or encroach on right-of-way limits. Slopes shall not extend lower than one foot above the top of the pipe.

201-1.6.3. MECHANICAL EXCAVATION

The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, and other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.

Mechanical excavation equipment used for trench excavation shall be of the type, design, and construction, and shall be so operated, such that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from an elevation one foot above the top of the installed pipe to the bottom of the trench, and that trench alignment is such that the pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance shall not be permitted.

201-1.6.4. PAVEMENT CUTTING

Cuts in concrete pavement, asphalt pavement, and asphaltic base pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be started with an asphalt or concrete saw in a manner which will provide a clean groove for the full depth of pavement along each side of the trench and along the perimeter of cuts for structures.

Asphalt pavement and asphaltic base pavement over trenches excavated for pipelines shall be removed so that a shoulder not less than 6-inches in width at any point is left between the cut edge of the pavement and the top edge of the trench. Trench width at the bottom shall not be greater than at the top and no undercutting shall be permitted. Pavement cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the centerline of the trench.

Pavement removed for connections to existing lines or structures shall not be greater than necessary for the installation as determined by the Engineer. Road restoration shall be full road width.

201-1.6.5. ARTIFICIAL FOUNDATIONS IN TRENCHES

Whenever so ordered by the Engineer due to the presence of unsuitable material at the designed depth, the Contractor shall excavate to such depth below grade as the Engineer may direct and the trench bottom shall be brought to grade with such material as the Engineer may order installed. All piling, concrete, or other

foundations made necessary by unstable soil shall be installed as directed by the Engineer. Compensation for extra excavation and piling, concrete, or other foundations, except where provided by contract unit prices, shall be made in accordance with the contract provisions for extra work.

201-1.6.6. BELL HOLES

Bell holes shall provide adequate clearance for tools and methods used in installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

201-1.7. UNDERCUT OF EXCAVATIONS

If the bottom of any structure or trench excavation is below that shown on the Drawings or specified because of Contractor error, convenience, or unsuitable subgrade due the Contractor's excavation methods, the Contractor shall refill to normal grade with approved fill at his own cost. Fill material and compaction method shall be as directed by the Engineer.

201-1.8. STABILIZATION OF EXCAVATIONS

Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact.

Subgrades for concrete structures or trench bottoms which are otherwise solid, but which becomes mucky on top due to construction operations, shall be reinforced with one or more layers of crushed rock or gravel. Not more than 1/2-inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon. The finished elevation of stabilized subgrades for concrete structures shall not be above subgrade elevations shown on the Drawings.

All stabilization work shall be performed by and at the expense of the Contractor.

201-1.9. BACKFILL AND COMPACTION

201-1.9.1. MATERIALS

- A. To the maximum extent available, excess earth obtained from structure and trench excavation shall be used for the construction of fills and embankments.
- B. Materials used as backfill shall be free from rocks or stones larger than 1-1/2-inches in their greatest dimension; brush or vegetation, stumps, logs, roots, debris, and organic or other deleterious materials; and must be acceptable to the Engineer.
- C. Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the Engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials be in any backfill, fill or embankment.

201-1.9.2. BACKFILL PLACEMENT AND COMPACTION

- A. Backfill materials shall be placed in approximately horizontal layers not to exceed 8-inches in uncompacted thickness. Material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled before compaction.
- B. Each layer of material being compacted shall have the optimum uniform moisture content to ensure satisfactory compaction. The Contractor shall be required to add water and harrow, disc, blade, or otherwise work the material in each layer to ensure uniform moisture content and adequate compaction.

- C. Each layer shall be thoroughly compacted by rolling or other method acceptable to the Engineer to 95% of relative density at optimum moisture content as determined by Modified Proctor Method, ASTM D1557, latest revision.
- D. Whenever a trench passes through a backfill or embankment area, material shall be placed and compacted to an elevation 12-inches above the top of the pipe before the trench is excavated.
- E. Backfill and compact excavations and construct embankments for structures according to the schedule listed in *Table 201-B*. Backfill and bedding schedule for pipes is listed in *Table 201-C*. (Modified Proctor for compaction shall be as determined by ASTM D-1557, latest revision).
- F. Pipe shall be laid in open trenches unless otherwise indicated on the Drawings or elsewhere in the Contract Documents.
- G. Excavations shall be backfilled to the original grade or as indicated on the Drawings. Deviation from this grade because of settling shall be corrected. Backfill operation shall be performed to comply with all rules and regulations and in such a manner that it does not create a nuisance or safety hazard.
- H. Embankments shall be constructed true to lines, grades and cross sections shown on the plans or ordered by the Engineer or the city. Embankments shall be placed in successive layers of not more than 8-inches in thickness, loose measure, for the full width of the embankment. As far as practicable, traffic over the work during the construction phase shall be distributed so as to cover the maximum surface area of each layer.
- I. If the Contractor requests approval to backfill material utilizing lifts and/or methods other than those specified herein, such request shall be in writing to the Engineer. Approval will be considered only after the Contractor has performed tests, at the Contractor's expense, to identify the material used and density achieved throughout the backfill area utilizing the method of backfill requested. The Engineer's approval shall be in writing.

201-1.9.3. STRUCTURE FOUNDATION PREPARATION

The existing ground beneath proposed tankage, building foundations and equipment base slabs and slabs on grade shall be removed and the area proof rolled. Proof-rolling should consist of at least 10 passes of a self-propelled vibrator compactor capable of delivering a minimum impact force of 30,000 to 35,000 pounds per drum to the soils. Each pass should overlap the preceding pass by 30 percent to insure complete coverage. Backfilled areas shall be compacted in 8-inch layers to a density of not less than 95 percent of Modified Proctor Dry Density as determined by ASTM D1557, latest revision, for a depth of not less than 2-feet below the bottom of the foundations or concrete slabs. Any unsuitable foundation material shall be removed and replaced with suitable material.

Slabs on Grade: Subgrades for concrete slabs shall be removed, backfilled, and compacted to the required grade. The top 2-feet of concrete slab subgrade in cut sections and all fill material shall be compacted in 8-inch layers to a density of not less than 95 percent of Modified Proctor Dry Density as determined by ASTM D1557, latest revision.

201-1.10. DRAINAGE FROM EXCAVATIONS

Trenches across roadways, driveways, walks, or other traffic ways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the traffic way to prevent impounding water after the pipe has been laid.

Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches.

All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the original sections, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

201-1.11. FINAL GRADING

After other outside work has been finished, and backfilling completed and settled, all areas on the site of the work which are to be graded shall be brought to grade within the tolerance of ± 0.1 feet at the indicated elevations, slopes, and contours where seeding or sodding is not required or, where sodding is required within three (3) inches of finished grade. Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to hand work. All surfaces shall be graded to secure effective drainage. Unless otherwise shown, a slope of at least one percent shall be provided.

After grading and where seeding is required, topsoil shall be evenly spread to a minimum depth of six (6) inches. Topsoil shall be from an Engineer approved source and shall be free of trash, debris and surface vegetation.

Grading and surfacing shall be completed to the satisfaction of the Engineer and the Owner.

201-1.12. EXCESS EXCAVATED MATERIAL

Insofar as needed, suitable excavated materials shall be used in fills and embankments as shown on the Drawings. All suitable excess excavated material shall be placed at an on-site stockpile area as directed by the city.

The Contractor shall segregate different types of excavated materials (i.e. sands, clayey sands) as much as possible in the stockpile areas. All unsuitable materials shall be disposed of by the Contractor offsite, in a legal manner.

The Contractor shall slope and compact the stockpile with a light roller type vehicle to maintain stability.

The Contractor shall maintain proper soil and erosion control measures.

201-1.13. SETTLEMENT

The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the guarantee period stipulated in the General Conditions of the Contract.

The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the Engineer or the city.

TABLE 201-A**STANDARD SIZES OF COARSE AGGREGATE AMOUNTS FINER****THEN EACH LABORATORY SIEVE (SQUARE OPENINGS), MASS PERCENT**

Aggregate Size No.	Nominal Size Square Openings	U. S. Sieve Size, Percent Passing By Weight								
		1-1/2-in	1-in.	3/4-in.	1/2-in.	3/8-in.	No. 4	No. 8	No. 16	No. 50
57	1-in. to No. 4	100%	95%-100%	--	25%-60%	--	0-10%	0-5%	--	--
68	3/4-in. to No. 8	--	100%	90%-100%	--	30%-65%	5%-25%	0-10%	0-5%	--
78	1/2-in. to No. 8	--	--	100%	90%-100%	40%-75%	5%-25%	0-10%	0-5%	--
89	3/8-in. to No. 16	--	--	--	100%	90%-100%	20%-55%	5%-30%	0-10%	0-5%

TABLE 201-B**COMPACTION AND BACKFILL SCHEDULE****FOR STRUCTURES**

Area	Material	Compaction
Beneath structures, foundations, slabs, and pavements. (minimum 2-foot depth below concrete foundation bottom)	Structural Fill (<i>Section 201-2.2.</i> , Structural Fill)	8-inch lifts compacted to 95% Modified Proctor maximum dry density (98% Modified Proctor maximum dry density under pavement). Fill should not be placed over any in-place soils until those layers have been compacted to 95% Modified Proctor maximum dry density (98% Modified Proctor maximum dry density under pavement).
Around structures, foundations and slabs (minimum 5-foot outside structure)	Structural Fill (<i>Section 201-2.2.</i> , Structural Fill)	8-inch lifts compacted to 95% Modified Proctor maximum dry density (98% Modified Proctor maximum dry density under pavement). Use light rubber-tired or vibratory plate compactors.
From cleared existing surface to subgrade for paved and gravel roadway surfaces	Common Fill (<i>Section 201-2.2.</i> , Common Fill)	12-inch lifts, compacted to 95% Modified Proctor maximum dry density (98% Modified Proctor maximum dry density under pavement).
Disturbed area requiring seeding and mulching	Topsoil	2-inch to 4-inch lifts, compacted to 85% Modified Proctor maximum dry density.

202. OBSTRUCTIONS

Any pipes, conduits, wires, mains, footings, driveways, or other structures encountered shall be carefully protected from damage or displacement. Any damage thereto shall be fully, promptly, and properly repaired by the Contractor to the satisfaction of the Engineer and the city of Clearwater thereof. Any survey monument or benchmark which must be disturbed shall be carefully referenced before removal, and unless otherwise provided for, shall be replaced upon completion of the work by a Florida registered Professional Surveyor and Mapper (PSM). Any concrete removed due to construction requirements shall be removed to the nearest expansion joint or by saw cut. Contractor shall consult Inspector/Project Manager for the approved means of removal and replacement.

203. DEWATERING

203-1. GENERAL

The work to be performed under this Section shall include the design and installation of a temporary dewatering system(s) until completion of construction to remove subsurface waters from structure or utility trench excavations as required. The Contractor shall furnish all equipment; labor and materials necessary to remove storm water or subsurface groundwater from excavation areas in accordance with the requirements set forth, as shown on the Drawings, and/or geotechnical report.

Qualifications: For major dewatering activities the temporary dewatering system shall be designed, installed and operated by a firm who regularly engages in the design, installation and operation of dewatering systems and who is fully experienced, reputable, and qualified in the design, installation and operation of such dewatering systems. The firm shall have a successful record of operation for a minimum of five (5) years prior to bid date. The dewatering system firm shall have experience for installation of at least three (3) successful dewatering operations of a similar nature and size in the state of Florida.

The dewatering system shall be developed to the point that it is capable of dewatering the site surrounding all structures or utility trenches as shown on the Drawings. Each dewatering system shall be capable of dewatering and maintaining groundwater levels at the respective excavations. Observation wells shall be constructed for the purpose of testing each system.

The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove and dispose of all water entering excavations, and shall keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fill, structures or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural levels. In critical dewatering situations, the Contractor shall have on hand at the construction site, backup dewatering pumps and other critical components of the dewatering system that are operational and could be used in the event of breakdowns of the primary equipment.

The Contractor's plan shall include temporary culverts, barricades, and other protective measures to prevent damage to property or injury to any person or persons.

Prior to construction, the dewatering plan shall be prepared and submitted to the city's Engineering Department, Public Utilities Department, Industrial Pretreatment Program (IPP) Coordinator, Wastewater Environmental Manager and the Public Utilities Department Director or Assistant Director for review and approval. It shall include site-specific notes and details presenting the Contractor's proposed dewatering and disposal methods. The city will field-inspect the dewatering operation throughout construction.

All costs for dewatering shall be included in the unit price bid per linear foot of pipe, or, in the case of other underground structures, in the cost of such structures.

203-1.1. Definition of Terms for Dewatering System

Minor Dewatering Activity: A single stage well point dewatering system, operating for less than 30 days total duration, and not requiring a Notice of Dewatering Activity filed with the local Water Management District.

Major Dewatering Activity: Any major dewatering system, operating for more than 30 days duration, requiring a Notice of Dewatering Activity filed with the local Water Management District. Major dewatering systems shall include, but not be limited to, multi-stage well point dewatering systems, drilled horizontal or vertical sock drain systems, dewatering deep well pump systems and educator dewatering systems.

203-2. OBSERVATION WELLS

For major dewatering activities, prior to excavation, the Contractor shall install groundwater observation wells at locations as directed and designed by the Contractor's Geotechnical Engineer and as approved by the Engineer adjacent to structures or underground utility under construction for the purpose of monitoring water levels during excavations.

Where required, the observation well construction shall consist of well screen, casing, and cap of approved size and material of construction. The observation well shall be placed in a 2-1/2-inch bore hole which shall be carried to an elevation at least 4 feet below the final bottom grade of structure or utility trench excavation. The annular space surrounding the intake point and the riser pipe shall be sealed in such a way as to prevent infiltration from surface water. The observation well shall be developed in such a manner as to ensure proper indication of subsurface water levels adjacent to the well.

The Contractor shall be responsible for maintaining the observation wells and for observing and recording the elevation of groundwater until the structure or utilities requiring excavation are completed and backfilled. Each observation well shall be observed and recorded daily. Measurements shall be supplied daily to the Engineer and the city. The Engineer may require that the observation wells reflect true groundwater levels by adding water to the well, recording the drop in the level from the time the water was added. Any plugged observation well shall be redeveloped, if necessary, to indicate true groundwater levels.

Observation wells shall be fully grouted and abandoned when the dewatering system is removed as directed by the Geotechnical Engineer, and in a manner acceptable to the Geotechnical Engineer.

203-3. PUMPING AND DRAINAGE - GENERAL

Unless specifically authorized by the Engineer, all pipes, except sub drains, shall be laid "in the dry". In the dry shall be defined to be within 2 percent of the optimum moisture content of the soil. The Contractor shall dewater trench excavation as required for the proper execution of the work, using one or more of the following approved methods: well point system, trenched gravity under drain system, or sumps with pumps.

Well point systems must be efficient enough to lower the water level in advance of the excavation and maintain it continuously in order that the trench bottom and sides shall remain firm and reasonably dry. The well points shall be designed especially for this type of service, and the pumping unit used shall be capable of maintaining a high vacuum, and at the same time, of handling large volumes of air as well as of water.

Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils 2-feet below the proposed bottom of excavation and to preserve the integrity of adjacent structures. As a minimum, the water level shall be 2-feet below the trench bottom. Well or sump installations shall be constructed with proper sand filters to prevent drawing of finer grained soil from the surrounding soils. Dewatering by trench pumping shall not be permitted if migration of fine-grained natural material from bottom, side walls, or bedding material may occur.

A well point system, trench drain, sump pump operation, or other dewatering method shall be utilized to maintain the excavation in a dry condition for preparation of the trench bottom and until the structures or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural levels. No water shall be allowed to contact masonry or concrete within 24 hours after being placed.

Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and pumped from the excavation to maintain the excavation bottom free from standing water.

The Contractor shall take all additional necessary precautions and prevent uplift of any structure during construction.

Flotation of structures or piping shall be prevented by the Contractor by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages which may result from failure of the dewatering system.

The conveying of water other than storm water surface runoff in open ditches or trenches will not be allowed unless prior approval is obtained. Permission to use any drainage ditches, storm sewers, drains or other storm drainage facilities for water conveyance or disposal purposes during dewatering operations shall be obtained from the controlling authority having jurisdiction. Any requirements and costs for such use shall be the responsibility of the Contractor. However, the Contractor shall not cause flooding by overloading or blocking up the flow in the drainage facilities, and the Contractor shall leave the facilities unrestricted and as clean as originally found. Any damage to existing facilities shall be repaired or restored, as directed by the Engineer or the authority having jurisdiction, at no cost to the city or the Owner of the facilities.

The Contractor shall be responsible for disposing of all water resulting from trench dewatering operations and shall dispose of the water without damage or undue inconvenience to the work, the surrounding area, or the general public. The Contractor may be required to divert the water from the dewatering process to a location determined by the Engineer or city Project Manager or Inspector and obtain a discharge permit from Florida Department of Environmental Protection (FDEP). Alternatively, if Contractor elects to contain produced groundwater on the project site, a dewatering plan must be submitted to the Engineer or city for approval (even if a discharge permit is not required).

The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, or other contaminants in order to prevent adverse effects on groundwater or receiving water quality.

203-3.1. DEWATERING EQUIPMENT

The dewatering equipment shall be standard dewatering equipment of proven ability as designed, manufactured, and installed by firms having experience in the design and production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods.

The Contractor shall provide adequate equipment for the removal of surface or subsurface waters that may accumulate in the excavation. Flotation and migration of fines shall be prevented by the Contractor by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages that may result from the operation and/or failure of this system.

Sound levels for dewatering pumps shall meet governmental agencies ordinance levels. Sound levels in excess of such ordinance are sufficient cause to have the work halted until equipment can be quieted to these levels. Work stoppage by the Engineer, city or other governmental agencies for excessive noise shall not relieve the Contractor of the other portions of this specification including, but not limited to contract time and contract price. Engine-driven pumps shall be equipped with critical grade type silencers, sound blankets or other types of sound mitigation measures to comply with Noise Ordinances. Engine driven dewatering pumps shall have a maximum rating of 80 decibels at a distance of 5 feet from the engine for sound attenuation, nor shall the pump engine noise exceed 50 decibels at a distance of 50 feet from the engine. There may be practical and feasible, electrical "power drops" and electric motor-driven equipment shall be used in lieu of portable generators.

The dewatering system shall operate in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at the proposed structures or utilities and to preserve the integrity of any adjacent structures.

Removal of dewatering equipment shall be accomplished following backfilling and compaction, and after the Contractor and the Engineer both agree, that the system is no longer required. All materials and equipment constituting the dewatering system shall be removed by the Contractor.

Immediately upon completion of the dewatering operations, the Contractor shall remove all of his equipment, materials, and supplies from the site of the Work, remove all surplus materials and debris, fill in all holes or excavations, grout all groundwater monitoring wells installed for the dewatering operations and grade the site to elevations of the surface levels which existed before the work started. The site shall be thoroughly cleaned and graded as directed by the Engineer and approved by the city.

203-3.2. DEWATERING CONSIDERATIONS

The Contractor shall install a temporary dewatering system for the removal of subsurface water encountered during construction of the proposed structures or underground utilities. The Contractor shall provide adequate equipment for the removal of storm or subsurface waters which may accumulate in the excavations.

If well points are used, Contractor shall adequately space well points to maintain the necessary dewatering. Provide suitable filter sand and/or other means to prevent pumping of fine sands and silts. A continual check shall be maintained by the Contractor to ensure that the subsurface soil is not being removed by the dewatering operations. Pumping from well points shall be continuous and standby pumps shall be provided.

The Contractor's proposed method of dewatering shall include groundwater observation wells to determine the water level during construction. Observation wells shall be installed along pipelines as required to verify depth to water level and at locations approved by the Engineer.

At all times, site grading shall promote drainage. Surface runoff shall be diverted from excavations. Water entering the excavation from the surface shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and pumped or drained by gravity to maintain an excavation bottom free from standing water.

Flotation shall be prevented by the Contractor by maintaining a positive and continuous removal of water. The Contractor shall be fully responsible for all damages which may result from failure to adequately keep excavations dewatered.

The Contractor shall construct and place all pipelines, structures, concrete work, structural fill, backfill and bedding material in-the-dry. If subsurface water is encountered, utilize suitable equipment to adequately dewater the excavation so that it will be “in-the-dry” for work and pipe laying. For the purposes of this specification, “in-the-dry” is defined to be within ± 2 percent of the optimum moisture content of the soil. A well point system or other dewatering method accepted by the respective jurisdictional agency (agencies) shall be utilized, if necessary, to maintain the excavation in a dry condition for preparation of the trench bottom and for pipe laying. The Contractor shall not make the final 24-inches of excavation until the water level is a minimum of 2-feet below proposed bottom of the excavation.

Dewatering by trench pumping will not be permitted if migration of fine-grained natural material from bottom, side walls, or bedding material will occur.

In the event that satisfactory dewatering cannot be accomplished due to subsurface conditions or where dewatering could damage existing structures, obtain the Owner’s and the Engineer's approval of wet trench construction procedures before commencing construction.

203-3.3. DISPOSAL OF PUMPED WATER

Discharge water to on-site disposal areas (if shown on the Drawings) or as required by permits.

The Contractor shall dispose of water from the Work in a suitable manner without damage to adjacent properties or facilities. No water shall be discharged without appropriate treatment for adverse contaminants. No water shall be drained in work built or under construction without prior consent from the Owner. Water shall be filtered to remove sand and fine soil particles before disposal into any drainage system.

Discharge water from dewatering operations to temporary infiltration pits, if possible.

Discharge to storm sewers, canals, stream, or wetlands, only if specifically allowed for in Dewatering Permit.

No discharges from dewatering operations shall be allowed to wastewater collection systems or wastewater pumping stations at any time.

In no case, shall discharges from dewatering operations result in turbidity reaching wetlands or any waterways. If turbidity exceeds limits allowed by jurisdictional permitting agency(ies), stop all activities, and install additional erosion and sedimentation control as required by the Southwest Florida Water Management District or the FDEP.

Flooding of streets, roadways, driveways, or private property shall not be permitted during dewatering activities. Contractor shall not dam-up, divert, or cause water to flow in excess in existing gutters, roadway pavements or other structures. For proper water discharges and disposal from dewatering operations, the Contractor may be required to divert or provide discharge piping to transport the water to a suitable place for legal discharge, as determined by the Engineer and the city.

203-3.4. GROUNDWATER TREATMENT (IF REQUIRED)

If the concentrations of tested groundwater quality parameters exceed those allowable in the FDEP Generic Permit for the Discharge of Produced Groundwater from any Non-Contaminated Site Activity (62-621.300(2), F.A.C.), the Contractor shall treat the effluent discharged from the dewatering system.

The Contractor shall immediately notify the Engineer and the city Engineering Department and discuss the parameters that exceed allowable limits.

The Contractor shall meet with the FDEP to determine treatment and disposal alternatives that are acceptable to the FDEP.

The Contractor shall apply for and obtain any and all permits and/or treatment approvals that FDEP requires including but not limited to the following:

1. Generic Permit for Discharges from Petroleum Contaminated Sites (62-621.300(1)). Allows discharges from sites with automotive gasoline, aviation gasoline, jet fuel, or diesel fuel contamination; or,
2. Permit for all Other Contaminated Sites (62-04; 62-302; 62-620 & 62-660). The coverage is available only through the individual NPDES permit issued by FDEP, allows discharges from sites with general contaminant issues i.e. ground water and/or soil contamination other than petroleum fuel contamination; or,
3. Generic Permit for the Discharge of Produced Ground Water from Any Non-Contaminated Site Activity (62-621.300(2), F.A.C.); or,
4. Generic Permit for Stormwater Discharge from Large or Small Construction Activities (62-621.300(4)(a), F.A.C.); or,
5. An Individual Wastewater Permit (62-604.300(8) (a).

The Contractor shall implement the appropriate treatment that is acceptable to FDEP, the Engineer and the city to attain compliance for all excess limits encountered during dewatering activities. Treatment may include, but is not limited to: Chemical, Physical, Biological, Electrolysis, Ion Exchange, Aeration, Activated Carbon Absorption, or any combination of the these.

The Contractor shall make every effort to minimize the spread of contamination into uncontaminated areas. Provide for the health and safety of all workers at the job site and make provisions necessary for the health and safety of the public that may be exposed to any potentially hazardous conditions. Ensure provision

adhere to all applicable laws, rules or regulations covering hazardous conditions and will be in a manner commensurate with the level of severity of the conditions.

If necessary, provide contamination assessment and remediation personnel to handle site assessment, determine the course of action necessary for site security and perform the necessary steps under applicable laws, rules and regulations for additional assessment and/or remediation work to resolve the contamination issue.

Delineate the contamination area(s) and any staging or holding area required and develop a work plan that will provide the schedule of projected completion dates for the final resolution of the contamination issue.

Maintain jurisdiction over activities inside any delineated contamination areas and any associated staging or holding areas. Be responsible for the health and safety of workers within the delineated areas. Provide continuous access to representatives of regulatory or enforcement agencies having jurisdiction.

203-4. PERMIT REQUIREMENTS

The dewatering of any excavation areas and the disposal of water during construction shall be in strict accordance with the latest revisions of the National Pollutant Discharge Elimination System (NPDES), and all local and state government rules and regulations.

The Contractor shall be responsible for submitting the Notice of Intent to use the Generic Permit for the Discharge of Groundwater from Dewatering Operations and associated fee in accordance with FDEP Requirements, F.A.C. 62-621.300(2)(b) and must receive written notice from the FDEP prior to discharging produced groundwater into the city's streets, storm sewers or waterways.

The Contractor shall obtain and pay all respective fees for all local, state, and federal permits required applicable to the withdrawal, treatment and disposal/discharge of water produced from the dewatering operations, prior to the start of work.

Contractor shall be responsible for acquiring and complying with all permits required to discharge produced water from dewatering and shall protect waterways from turbidity during the operation. Prior to discharging produced groundwater from any construction site, the contractor must collect samples and analyze the groundwater, which must meet acceptable discharge limits per FDEP "Generic Permit for the Discharge of Produced Ground Water from Any Non-Contaminated Site Activity" Chapter 62-621.300(2), FAC. The Contractor shall have on-site and available for review the analytical testing results performed in accordance with FDEP Chapter 62-621.300(2), FAC.

Consumptive Use Permit (CUP): If pumping requirements exceed certain limits, the Contractor shall pay for and obtain a CUP from the regional Water Management District for such pumped volumes. If a consumptive use permit is required by the local Water Management District, the Contractor shall be responsible for obtaining said permit. Comply with all conditions of the Dewatering Permit issued by the Water Management District. Apply for permit extensions or modifications, when required.

All water produced from dewatering shall be pumped from the trench or other excavation and shall be disposed of in strict accordance with applicable permits. The Contractor will be allowed to discharge product water from dewatering into storm sewers, or ditches having adequate capacity, canals or suitable disposal pits, or other surface waters in accordance with the Dewatering Plan, provided that the water has been sampled and tested by the Contractor, is in compliance with the concentration limits specified in 62-621.300(2) FAC, and the Contractor has obtained an FDEP Generic Permit for the production of groundwater. The frequency of water sampling and testing shall be determined by the Engineer based on existing conditions and field observations.

204. UNSUITABLE MATERIAL REMOVAL

All unsuitable material, such as muck, clay, rock, etc., shall be excavated from under pipes, structures and roadways and removed from the site. All material removed is property of the Contractor, who shall dispose of said material off-site at their expense. The limits and depths of the excavation shall be determined in the field by the Engineer. Approved replacement materials shall meet the requirements of Section 304.

204-1. BASIS OF MEASUREMENT

The basis of measurement shall be the number of cubic yards of clean fill placed as determined by either cross sections of the excavation, truck measure, or lump sum as specified in the Scope of Work and Contract Proposal. Included in the cost of removing unsuitable material is the cost to place suitable material/clean fill.

204-2. BASIS OF PAYMENT

The unit price for the removal of unsuitable material shall include: all materials, equipment, tools, labor, disposal, hauling, excavating, dredging, placing, compaction, dressing surface and incidentals necessary to complete the work. If no pay item is given, the removal of unsuitable material shall be included in the most appropriate bid item.

205. UTILITY TIE IN LOCATION MARKING

The tie in locations for utility laterals of water, sanitary sewer, and gas shall be plainly marked on the back of the curb. Marking placed on the curb shall be perpendicular with respect to the curb of the tie in location on the utility lateral. Marks shall not be placed on the curb where laterals cross diagonally under the curb. The tie in location shall be the end of the utility lateral prior to service connection.

Markings shall be uniform in size and shape and colors in conformance with the current code adopted by the American Public Works Association:

SAFETY RED	Electric Power Lines, Cables, Conduit and Lighting Cables
HIGH VISIBILITY SAFETY YELLOW	Gas, Oil, Steam, Petroleum or Gaseous Materials
SAFETY ALERT ORANGE	Communication, Alarm or Signal Lines, Cables or Conduit
SAFETY BLUE	Potable Water
SAFETY GREEN	Sewer Systems and Drain Lines
PURPLE	Reclaimed Water, Irrigation and Slurry Lines
WHITE	Proposed Excavation
PINK	Temporary Survey Markings

Marks placed on curbs shall be rectangular in shape and placed with the long dimension perpendicular to the flow line of the curb. Marks placed on valley gutter and modified curb shall be six-inch (6") x three inch (3") and placed at the back of the curb. Marks placed on State Road and vertical curb shall be four-inch (4") x two inch (2") and be placed on the curb face.

206. CLEARING AND GRUBBING

The work included in this specification includes the removal and disposal of all structures, appurtenances, asphalt, concrete, curbs, walls, trees, roots, vegetation, boulders, conduits, poles, posts, pipes, inlets, brush, stumps, debris and other obstructions resting on or protruding through the ground surface necessary to prepare the area for construction.

Clearing and grubbing shall be performed in accordance with *Section 110 of FDOT's Standard Specifications*. Unless otherwise specified in the contract documents, the Contractor shall take ownership of all removed material and dispose of them off-site in accordance with all Local, State and Federal Requirements.

206-1. BASIS OF MEASUREMENT

The basis of measurement shall be either a lump sum quantity or the number of acres cleared and grubbed as specified on the plans or directed by the Engineer.

206-2. BASIS OF PAYMENT

The pay item for clearing and grubbing shall include: all removal and disposal of materials and structures as well as all materials, hauling, equipment, tools, labor, leveling of terrain, landscape trimming and all incidentals necessary to complete the work.

207. EROSION AND SEDIMENT CONTROL

207-1. GENERAL

Erosion and sediment control shall conform to the requirements of the FDOT Standard Specifications for Prevention, Control, and Abatement of Erosion and Water Pollution. Contractor shall use temporary erosion and sediment control features found in the State of Florida Erosion and Sediment Control Designer and Reviewer Manual (E&SC Manual) or the city of Clearwater Standard Indices. Contractor shall prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) and National Pollutant Discharge Elimination System (NPDES) permit in accordance with FDEP criteria for an NPDES construction activity permit.

Visit www.dep.state.fl.us/water/stormwater/npdes for more information. Contractor shall obtain a FDEP generic permit for the discharge of produced groundwater. All soil erosion and sediment control measures shall be installed prior to disturbance and maintained through project completion.

207-2. TRAINING OF PERSONNEL

The city may require that the Supervisor or Foreman controlling the work for the Contractor on the Project have a current FDEP Florida Stormwater, Erosion, and Sedimentation Control Inspector Training & Certification. All personnel working on the Project shall complete illicit discharge training once per calendar year. Contractor shall provide documentation to the city prior to Notice to Proceed (NTP). Example of training and training sign-in sheet will be provided by the city to the Contractor at the Pre-Construction Meeting.

207-3. STABILIZATION OF DENUDED AREAS

No disturbed area may be denuded for more than thirty (30) calendar days unless otherwise authorized by the City Engineer. During construction, denuded areas shall be covered by mulches such as straw, hay, filter fabric, seed and mulch, sod, or some other temporary vegetation. Within sixty (60) calendar days after final grade is established on any portion of a project site, that portion of the site shall be provided with established permanent soil stabilization measures per the original site plan, whether by impervious surface or landscaping.

207-4. PROTECTION AND STABILIZATION OF SOIL STOCKPILES

Fill material stockpiles shall be protected at all times by on-site drainage controls which prevent erosion of the stockpiled material. Control of dust from such stockpiles may be required, depending upon their location and the expected length of time the stockpiles will be present. In no case shall an un-stabilized stockpile remain after thirty (30) calendar days.

207-5. PROTECTION OF EXISTING STORM SEWER SYSTEMS

During construction, all storm sewer inlets in the vicinity of the project shall be protected by temporary erosion and sediment control features found in the State of Florida Erosion and Sediment Control Designer and Reviewer Manual (E&SC Manual) or the city of Clearwater Standard Indices, or equals approved by the City Engineer before installation.

207-6. SWALES, DITCHES AND CHANNELS

All swales, ditches and channels leading from the site shall be sodded within three (3) days after finished grade is established. All other interior swales, etc., including detention areas will be sodded and maintained by the Contractor prior to issuance of a Certificate of Occupancy.

207-7. UNDERGROUND UTILITY CONSTRUCTION

The construction of underground utility lines and other structures shall be done in accordance with the following standards: no more than 400 linear feet of trench shall be open at any one time; and, wherever consistent with safety and space consideration, excavated material shall be cast to the uphill side of trenches. Trench material shall not be cast into or onto the slope of any stream, channel, road ditch or waterway. No trench shall be open at the end of a workday, weekdays, or weekends.

207-8. MAINTENANCE

All erosion and siltation control devices shall be checked daily by the Contractor, especially after each rainfall. The erosion and sedimentation control devices shall be cleaned out and/or repaired as required so sediment removal for the device does not exceed fifty (50) percent of its capacity. Contractor shall prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) Construction Inspection Report on a weekly basis and within 24 hours of a storm that is 0.50 inches or greater. No additional payment will be made to the Contractor for the re-establishment of erosion control devices which may become damaged, destroyed, or otherwise rendered unsuitable for their intended function during the construction of the Project. Near completion of the project, after obtaining written approval by the Engineer, the Contractor shall dismantle and remove the temporary devices used for sediment control during construction. All erosion control devices in seeded areas shall be left in place until the grass is established. Seed areas around devices, and mulch after removing or filling temporary control devices. Cleanup all areas.

207-9. COMPLIANCE

Failure to comply with the aforementioned requirements as determined by the city's project manager or inspector may result in a fine and/or more stringent enforcement procedures such as (but not limited to) issuance of a "Stop Work Order".

208. CONSTRUCTION AND REPAIR OF SEAWALLS AND OTHER BEACH EROSION CONTROL STRUCTURES

208-1. EXISTING SEAWALLS AND REVETMENTS

Existing seawalls and revetments on natural water bodies may be replaced with a revetment or with a vertical seawall with the provision of rip rap placed at the base of the wall up to the mean high water line for the entire length of the seawall. Revetments and seawalls may be replaced with a vertical seawall in manmade water bodies, provided that the seawall is within the property line and maintains the established shoreline.

208-2. TOP OF CAP ELEVATION

The top of cap elevation for all replacement and new seawalls and seawall caps shall not exceed 4.8 feet North American Vertical Datum (NAVD 88) If the top of a seawall cap is constructed at an elevation differing from the adjacent property owner top of cap elevation by greater than one foot, then a return wall is required to sufficiently provide for the break in grade at the property line. Seawalls exceeding 4.8 feet NAVD 88 in height prior to the effective date of this Section may be maintained, repaired, and replaced to their current height.

208-3. SEAWALLS AND REVETMENTS LOCATED SEAWARD OF THE CCL

Seawalls and revetments located seaward of the coastal construction setback line are controlled by regulations of the Division of Beaches and Shores of the Florida Department of Environmental Protection. Replacement of a seawall or revetment that is located seaward of the coastal construction setback line necessitates submission of a permit application to the state department of environmental protection.

208-4. PLACEMENT OF NEW SEAWALL

The placement of a new seawall waterward of an existing seawall is permitted, subject to the following conditions:

- A. A Florida registered professional engineer must certify the new seawall design.
- B. The new seawall shall not extend more than 18 inches from the waterward face of the original alignment of the existing vertical seawall location.
- C. The new seawall shall be placed vertically plumb.
- D. Placing a seawall in front of an existing seawall shall only be permitted once unless the seawall behind the new seawall is removed.
- E. Existing seawall sections that interfere with new seawall location shall be removed.
- F. The new seawall shall include an adequate closure of gaps at each property line.
- G. For zoning purposes, the setbacks for the property will be measured from either the property line or the waterside of the original seawall slab, whichever is more restrictive, and will not be adjusted to accommodate the new seawall addition. For purposes of pier construction, the shore normal dimensions will be measured from the waterside of the original seawall slab.

208-5. POST CONSTRUCTION SURVEY

Prior to final inspection and approval of a new or replacement seawall or seawall cap, a post-construction survey shall be required. Repairs of existing seawalls and seawall caps which do not alter the height or location shall not be subject to this requirement.

208-6. RIP-RAP

On all-natural waterways, an apron of rip-rap shall be placed at the base of all new and repaired seawalls up to the mean high water line for the entire length of the seawall to absorb the wave energy and protect the underlying soft earth or sand from being carried away, as well as to provide habitat for desirable marine species. This rip-rap shall be required at the base of all new seawalls and at the time that an existing seawall is repaired where the replacement constitutes greater than 50 percent of the entire length of the seawall or includes the replacement of a panel.

208-7. RETAINING WALL IN LIEU OF VERTICAL SEAWALL

A retaining wall may be built as an alternative to a vertical seawall, provided that all activities, including dredging, filling, slope grading, or equipment access and similar activities and all portions of the wall are located landward of the mean high water line.

209. MAINTENANCE OF OPERATIONS

209-1. GENERAL

This Section sets forth the requirements for scheduling and performing the work to keep existing utilities in continuous, reliable operation.

The Contractor shall furnish all labor, materials, equipment, and incidentals necessary to maintain existing utilities service during construction. Contractor shall also keep on hand adequate equipment, supplies, and incidentals to repair pipe breaks and to contain and dispose of all spilled materials.

209-2. EXECUTION

- A. Before any work begins, the Contractor shall submit for city review a Maintenance of Flow Plan. The Maintenance of Flow Plan shall include all procedures to be performed by the Contractor to maintain continuous operation of the city's existing utility services. The Plan shall also include emergency response and remedial action measures.

Maintenance of Flow Plan:

1. The Contractor shall prepare a Maintenance of Flow Plan with two points of contact that describes in detail the work that will be performed by the Contractor to maintain continuous operation of the city's existing utility services. Maintenance of Flow Plan shall address the temporary and permanent flow diversion of utilities and other city facilities.
2. Temporary diversion of the utility flows shall be done using a minimum of two (2) bypass pumps (one duty, one standby) to pump from the upstream manhole to the downstream manhole. Bypass pumps shall have hospital grade sound attenuation. The Contractor shall obtain peak wet weather flow rates in the utility from the city and shall demonstrate in the Maintenance of Flow Plan that adequate pumping capacity is provided to accommodate peak wet weather flow. The Contractor and city personnel that are experienced in the

collection system shall determine the float levels in the field, pump on, standby or lag pump on, and high-level alarm. The Contractor shall have full responsibility for the operation and management of the temporary diversion/ bypass. The high-level alarm shall be connected to an auto dialer or remote monitoring system to notify the Contractor of an alarm condition. The bypass pump suction manhole shall use the collection system for a temporary wet well storage; however, surcharging in the existing utility system shall be limited. Once the high-level float alarm is triggered, it shall allow enough time for emergency Contractor personnel to arrive on scene and resolve the problem prior to any utility overflows. The bypass suction and discharge pipes may require the removal of the manhole tops which will result in excess odor escaping from the manholes. The Contractor shall provide a means to seal odors within the bypass manholes to minimize odors during the temporary diversion.

3. The Maintenance of Flow Plan shall include a sequence of construction with projected time, in days, for each step in the sequence.
 4. If the work required to maintain utility operation must occur during evening, night or weekend hours, the Contractor shall notify the affected residents in advance of the projected work. The Contractor shall reimburse the city for overtime work, including inspector overtime, in excess of regular working hours. The Contractor must also get permission from city Project Manager before working outside of Noise Ordinance hours.
 5. Identify the person(s) responsible for executing the Maintenance of Flow Plan and the systems to be put in place for monitoring the existing utility system's ability to maintain flow.
- B. All utility relocation work shall be completed prior to construction. The Contractor shall familiarize himself with the site, including the locations, sizes, and conditions of the existing utilities in and around the work zones where relocation of existing utilities is required. The location of storm sewer inlets, drainage swales, and runoff patterns should be identified, and a Plan developed to contain potential releases.
 - C. The Contractor shall carry out his operations in accordance with all applicable OSHA regulations, including confined space entry requirements, as well as local, city, and state requirements, and in accordance with the approved MOT plan. In addition, the Contractor shall protect the public from harm while performing the work by using barricades, warning lights and other means as necessary.
 - D. The Contractor shall keep existing utilities in service during all phases of construction and coordinate any system shutdowns with the city sufficiently in advance to provide alternative service. The Contractor shall provide a minimum of 10 days' notice. Contractor shall protect the city's utility system for any spills or overflows during construction. The city's Project Manager and Dispatch (727-462-6633) shall be notified of any spills or overflows immediately.
 - E. Any temporary work, facilities, roads, walks, protection of existing structures, piping, blind flanges, valves, equipment, etc. that may be required shall be furnished and maintained by the Contractor. The cost shall be included in the appropriate bid items.
 - F. The Contractor shall schedule the work in such a manner so that all existing utility systems are maintained in continuous operation. All short-term or partial utility system shutdowns shall be approved in writing by the city. If, in the opinion of the city, a shutdown is not required in order for the Contractor to perform the work, the Contractor shall utilize alternative methods to accomplish the work. The city shall be provided a minimum of ten (10) business days' notice of Contractor's need for any existing utility system shutdown or if there is a need of assistance from the Public Utilities Department. Contractor must also provide the city with at least two (2) business days' notice before Contractor is allowed to work at city facilities.
 - G. Required shutdowns shall not begin until all materials are on-hand, pre-assembled, as possible, and ready for installation. Upon commencement of the shutdown period, the Contractor shall proceed with the work continuously, start to finish, until the work is completed, and the system is tested, cleared for service, and ready for operation. If the Contractor completes all required work before

the specified shutdown period has ended, the city may immediately place the system back in service.

- H. The city shall have the sole authority to prohibit or order work stopped. The city reserves the right to cancel scheduled shutdowns if conditions warrant. Delays to the Contractor caused by cancellations will be considered in evaluating requests for a time extension. They will not be considered an entitlement to additional compensation. However, compensation may be considered at city's sole discretion.
- I. During inclement weather, all work which might be damaged or rendered inferior by such weather conditions shall be suspended. The orders and decisions of the city as to suspensions shall be final and binding. During suspension of the work from any cause, the work shall be suitably covered and protected to preserve it from injury by the weather or otherwise, if the city shall so direct surplus materials shall be removed. Contractor shall protect the city's utility system from inflow during inclement weather during the construction.
- J. The Contractor shall submit a Critical Path Method (CPM) work schedule at the pre-construction meeting showing all critical items of work and anticipated shut down times. Note that no activity will be allowed until the CPM is approved by the city or the Engineer of Record (EOR).
- K. Contractor must submit a detailed schedule and process description for proposed testing. Training of all new equipment must be videotaped including two weeks of training prior to startup. If there are multiple sites under the same contract each site startup shall occur as soon as it is complete. If there are multiple shifts at any site(s) where city staff require training, Contractor shall hold multiple trainings convenient for each shift.
- L. Required shutdowns shall not begin until all materials are on-hand, pre-assembled to the extent possible, and ready for installation. Upon commencement of the shutdown period, the Contractor shall proceed with the work continuously, start to finish, until the work is completed, and the system is tested, cleared for service, and ready for operation. If the Contractor completes all required work before the specified shutdown period has ended, the city may immediately place the system back in service.

209-3. BASIS OF MEASUREMENT

There shall be no separate measurement and payment for this task.

210. DETECTION OF FACILITIES

The locations of all existing underground piping, structures, and other facilities are shown based on information received from the respective owner. The locations are shown without express or implied representation, assurance, or guarantee that they are complete, correct, or represent a true picture of the actual underground facilities to be encountered. It is the Contractor's responsibility to verify the correct location and sizing of all utilities (including connection points).

All appropriate utility companies and agencies shall be contacted 72 hours prior to excavation. Call "One Call"/ "Sunshine 811" at 8-1-1; "Sunshine 811" administrative offices may be reached at (800) 638-4097.

The Contractor shall at all times employ acceptable methods and exercise reasonable care and skill so as to avoid unnecessary delay, injury, damage, or destruction of existing utilities or cause interference.

The Contractor shall conduct exploratory excavations as necessary for the purpose of locating underground pipelines, structures, and utilities in advance of construction. Test pits shall be excavated in areas of potential conflicts between existing and proposed facilities and at piping connections to existing facilities a minimum of 48 hours and 1000 ft in advance of work. If there is a potential conflict, the Contractor shall notify the Owner and Engineer immediately and provide as much information as possible including but not

limited to location, elevation, utility type, material, and size. Test pits shall be backfilled immediately after their purpose has been satisfied. There shall be no additional compensation for exploratory excavations.

211. RELOCATIONS

211-1. RELOCATION SHOWN ON DRAWINGS

Relocations shown on the Drawings: Public utility installations or structures, including but not limited to poles, signs, fences, piping, conduits and drains that interfere with the positioning of the work which are shown on the Drawings to be removed, relocated, replaced or rebuilt by the Contractor shall be considered as part of the general cost of doing the Work and shall be included in the prices bid for the various contract items. No separate payment shall be made, therefore.

All existing castings, including valve boxes, junction boxes, manholes, hand holes, pull boxes, inlets and similar structures in the areas of construction that are to remain in service and in areas of trench restoration and pavement replacement, shall be adjusted by the Contractor to bring them flush with the surface of the finished work.

All existing utility systems which conflict with the construction of the work herein, which can be temporarily removed and replaced, shall be accomplished at the expense of the Contractor. Work shall be done by the utility unless the utility approves in writing that the Work may be done by the Contractor.

211-2. RELOCATIONS NOT SHOWN ON DRAWINGS

Where public utility installations or structures are encountered during the course of work, and are not indicated on the Drawings or in the specifications, and when in the opinion of the city, removal, relocation, replacement, or rebuilding is necessary to complete the work, such work shall be accomplished by the utility having jurisdiction or such work may be requested in writing by the city for the Contractor to perform and fairly compensated once work is complete.

If such work is accomplished by the utility having jurisdiction, it will be carried out expeditiously and the Contractor shall give full cooperation to permit the utility to complete the removal, relocation, replacement, or rebuilding as necessary.

212. RESTORATION PROCEDURES

212-1. INTERIM RESTORATION

All excavations shall be backfilled and compacted as specified by the city and Engineer at the end of each working day. For excavations within existing paved areas, the limerock base or soil cement base shall be spread and compacted to provide a smooth surface free of aggregate material. The Contractor shall keep the site accessible to the city Staff at all times for the purpose of operating and maintaining the existing facility during construction.

All pipe and fittings shall be neatly stored in a location, which will cause the least disturbance to the public. All debris shall be removed and properly disposed of by the end of each working day.

212-2. FINAL RESTORATION

After completing all installations, pressure testing, bacteriological testing, and associated work, final restoration shall be performed. In no event shall final restoration begin after substantial completion. Any

SECTION IV – Technical Specifications

additional restoration required after testing shall be repaired in a timely manner at no additional cost to the city. Maintenance of all restored facilities shall be the Contractor's responsibility. This maintenance shall be performed on an on-going basis during the course of construction. The Contractor's Progress Schedule shall reflect the above restoration requirements.

300 SERIES: MATERIALS

301. CONCRETE

The Contractor shall notify the Construction Inspector a minimum of twenty-four (24) hours in advance of all concrete placements. Contact Building Inspectors from the city Planning Department if building a structure is required. The Contractor shall give Building Inspectors a minimum of 48 hours in advance to inspect.

Unless otherwise noted elsewhere or directed, the following requirements shall be adhered to:

All concrete work shall be performed in accordance with the latest editions of the Design and Control of Concrete Mixtures by the Portland Cement Association, the American Concrete Institute, and FDOT's Standard Specifications. Unless otherwise specified, all concrete shall have fiber mesh reinforcing and have a minimum compressive strength of 3000 psi at twenty-eight (28) days. The cement type shall be Type I and shall conform to AASHTO M85 latest edition. The aggregate shall conform to ASTM C33 or latest current edition. All ready-mix concrete shall conform to ASTM C94 or latest edition. The slump for all concrete shall be in the range of three inches (3") to five inches (5"), except when admixtures or special placement considerations are required.

All concrete shall be tested in the following manner:

Placement of less than five cubic yards (5 cy) shall be tested at the Engineer's discretion. Otherwise, for each class, for each day, for every fifty cubic yards (50 cy) or part thereof exceeding five cubic yards (5 cy), one set of three (3) compressive strength cylinders will be required (1 at 7 days and 2 at 28 days). At the discretion of the Engineer, unacceptable test results may require the Contractor to provide further tests, as determined by the Engineer, to determine product acceptability, or need for removal, and compensation or denial thereof.

302. EXCAVATION AND FORMS FOR CONCRETE WORK

302-1. EXCAVATION

Excavating for concrete work shall be made to the required depth of the subgrade or base upon which the concrete is to be placed. The base or subgrade shall be thoroughly compacted to a point six inches (6") outside said concrete work before the forms are placed.

302-2. FORMS

Forms for concrete work shall be either wood or metal, except curbs. Curb forms shall be metal only, unless at radius, intermittent sections less than ten (10) linear feet or with written permission from the Engineer. The forms shall be free from warps or bends, shall have a depth equal to the dimensions required for the depth of the concrete deposited against them and shall be of sufficient strength when staked to resist the pressure of concrete without moving or springing.

303. REINFORCEMENT

When required, reinforcement shall be placed in the concrete work. Reinforcement deformation shall be performed as per ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement or latest edition. Reinforcement steel grades shall be billet intermediate or hard. Twisted Bars shall not be used, Fabric Reinforcement shall conform to the requirements of ASTM A1064

or latest edition that is relevant. Welded deformed steel wire fabric for Concrete reinforcement shall meet the requirements of AASHTO M 221 (ASTM A1064) or latest edition that is relevant. Welded wires shall be elevated with the use of chairs. Epoxy coated reinforcing Steel Bars shall meet ASTM A775/A77 requirements or latest edition.

303-1. BASIS OF PAYMENT

Reinforcement shall not be paid for separately. The cost of such work shall be included in the contract unit price for the item of work specified.

304. BACKFILL

304-1. MATERIALS AND GENERAL

Material for backfill other than under Gabion mattresses shall be carefully selected from the excavated material or from other sources as may be required by the Engineer. Such material shall be granular, free from any deleterious material including but not limited to clay, muck, organic matter or debris, contain no rocks or other hard fragments greater than three inches (3") in the largest dimension and all fill shall be similar material.

Material for backfill under Gabion mattresses shall be an A-1 soil meeting AASHTO M145 (latest edition).

Backfill shall be carried up evenly in layers not exceeding eight inches (8") in thickness and shall be compacted into place by mechanical tamping to 98% before the next layer is applied. A hydro-hammer shall not be used for compaction. Backfill placed around pipes shall be carefully placed below the pipe haunch, around the sides, and top of pipe by hand shovels and thoroughly compacted to twelve inches (12") above the pipe by tamping or other suitable means.

For backfill in small areas that do not permit any type of tamping, Contractor may use flowable fill to achieve required density. Refer to *Section 306* for more details on flowable fill. Where wet conditions are such that dewatering by normal pumping methods would not be effective, as determined by the Engineer, Contractor may use #57 stone (meeting FDOT's specifications) and hand tamping until backfill has reached an elevation and condition such as to make the use of the mechanical tampers practical. Fully wrap the stones with a layer of Type D filter fabric of *FDOT Index 199* (latest edition). Do not place stones within four feet (4') of the ends of trench or ditch; use normally accepted backfill material at the ends.

Where new cast-in-place concrete work is performed, do not place backfill until the specified twenty-eight (28) days compressive strength occurs.

Heavy construction equipment shall not be permitted to cross over pipes or culverts until placing and compacting backfill material to the finished earthwork grade or to an elevation of at least four feet (4') above the top of the pipe or culvert.

The cost of backfill, flowable fill, alternative approved material for wet conditions, and extra dewatering effort to achieve required density, etc., shall be included in the contract unit price or lump sum price for the item of the work specified.

304-2. TESTING AND INSPECTION

Contractor shall employ and pay for the services of an independent testing laboratory, approved by the Engineer, to perform density testing on backfilled material. All testing shall be witnessed by the Engineer's Representative. The test shall be repeated until satisfactory results are obtained. The Contractor shall be charged for all retests and re-inspection services.

Backfill under all types of pavement areas shall be compacted in layers not to exceed 6" in thickness unless an alternate method is approved by the Engineer. Backfill shall be a minimum of 98% compaction as determined by AASHTO T 180 - Modified Proctor Density Test (latest edition) to the bottom of pavement.

Backfill outside of pavement areas shall be compacted to the full depth to the ground surface to a minimum of 95% compaction as determined by AASHTO T 180 - Modified Proctor Density Test (latest edition).

Backfill under buried structures shall be in accordance with these specifications to prevent future subsidence.

Backfill Testing: The Contractor shall demonstrate the adequacy of backfill compaction by performing density testing. For each test location, density testing shall be performed at six-inch (6") lifts. The character of the backfill material will be observed during the excavation for density testing to determine conformance with the specifications. Density testing shall be performed using nuclear field density equipment or conventional weight-volume methods. If the weight-volume method is used, volume shall be determined by using the sand replacement test (ASTM D1556/ D1556M the latest edition) or liquid displacement methods (ASTM D2167 latest edition). If nuclear methods are used, the trench correction effect shall be accounted for by recalibrating the nuclear gauge on its calibration block at the location of each test prior to taking the density measurement. The Contractor shall furnish all equipment, tools, and labor to prepare the test site for testing.

Normal Testing Frequency: One test shall be performed for each one hundred feet (100') of backfill or fraction thereof or for each single run of pipe/culvert connecting two (2) successive structures whichever is less. The location of the test within each section shall be selected by the Engineer's Representative. Testing shall progress as each one hundred-foot (100') section is completed. Four (4) tests equally spaced around each structure shall be performed on each six-inch (6") lift. Testing which indicates that unacceptable material has been incorporated into the backfill, or that insufficient compaction is being obtained shall be followed by expanded testing to determine the limits of the unacceptable backfill.

Expanded Testing Requirements: If normal testing within a testing section indicates unacceptable backfill, the Engineer's Representative may require additional testing within the same test section to determine the limits of unacceptable backfill. Additional testing required by the Engineer's Representative shall be paid for by the Contractor and shall not exceed testing of four (4) additional locations within the test section. Unacceptable backfill within the limits established by the testing shall be removed and replaced by the Contractor at no additional cost to the city. Additional testing beyond that required may be performed by the Contractor at his expense to further delineate limits of unacceptable backfill.

305. RIPRAP

The work included in this specification includes the construction of riprap as shown on the plans. The riprap shall be constructed per *Section 530 of FDOT's Standard Specifications* (latest edition).

305-1. BASIS OF MEASUREMENT

The basis of measurement for riprap will be weight, in tons, in surface dry natural state. The scales must be calibrated and certified by an independent party and carry a state certification.

305-2. BASIS OF PAYMENT

The pay item for sand-cement riprap shall include: all materials, testing, labor, grout, hauling, equipment, excavation, backfill, dressing and shaping for placement of sand-cement and all incidentals necessary to complete the work.

The pay item for rubble riprap shall include: all materials, required bedding stone, dressing and shaping for placement of bedding stone, filter fabric, testing, hauling, excavating, backfill, dressing and shaping for placement of rubble, and all incidentals necessary to complete the work. No payment will be granted if concrete or stone that exists on-site is used as rubble riprap.

306. FLOWABLE FILL

Flowable fill is used in backfill and to fill all abandoned pipelines that are not removed. Mains that need to be abandoned shall be cut, capped, and filled with flowable fill meeting the requirements specified herein. Flowable fill shall adhere to Section 121 of FDOT specifications (latest edition).

The Contractor shall be responsible for producing a flowable mixture using these guidelines and adjusting his mixture design as called for by circumstances or as may be directed by the Engineer.

General mix requirements are as follows:

Components	Excavatable	Non Excavatable	Cellular Concrete
Cement (lb/yd ³)	75-100	75-150	Min 150
Supplementary Cementitious Materials (lb/yd ³)	None	150-600	
Fine Aggregate	*	*	*
Water	**	**	**
Air	5-35%	5-15%	***
Unit Weight (lb/ft ³)	90-110	100-125	20-80
28 Day Compressive Strength	****	****	****

* Fine aggregate shall be proportioned to yield 1 cubic yard (yd³).

** Mix design shall produce a consistency that will result in a flowable self-leveling product at the time of placement

*** In cellular concrete, preformed foam shall be proportioned at the jobsite to yield 1 cubic yard in accordance with design requirements

**** The requirements for percent air, compressive strength, and unit weight are for laboratory designs only and are not intended for jobsite acceptance requirements

Weights for fine aggregate and water shall be adjusted according to cementitious content. The mix proportions shall be adjusted for removability, pumpability and flowability. If required, strength test data shall be provided prior to batching.

If required by the Engineer, the flowability can be measured by afflux time determined in accordance with ASTM C939/ C939M – 16a (latest edition) and shall be 30 seconds +/- 5 seconds as measured on mortar passing the No. 4 sieve. The equipment required to perform this test shall be provided by the Contractor.

The Contractor shall flush all raw sewage, sludge, debris, and water from the force mains prior to filling pipeline with flowable fill. If not discharged into a sanitary sewer system, the Contractor shall collect all flushing water and dispose of at a wastewater treatment facility. City Public Utilities Department IPP Coordinator and Director and/or Assistant Director must approve of the discharge into the collection system or wastewater treatment plant.

The Contractor must locate and verify all connections of the piping before filling the pipeline with flowable fill to avoid redirection and reconnection and report them to the Engineer. During placement of fill, compensate for irregularities in sewer pipe, such as obstructions, open joints, or broken pipe to ensure no voids remain unfilled.

Clean placement areas of sewer and water lines of debris that may hinder fill placement. Remove excessive amounts of sludge and other substances that may degrade performance of fill. Remove free water prior to starting fill placement.

All proposed new force mains shall be installed, pressure tested, and placed in-service prior to abandoning the existing force mains. All pipes shall be abandoned in a manner which results in the abandoned pipeline not being pressurized.

Flowable fill shall be produced and delivered using concrete construction equipment. Placing flowable fill shall be by chute, pumping or other methods approved by the Engineer.

The flowable fill shall be placed to the designated fill line without vibration or other means of compaction. Placement shall be avoided during inclement weather, e.g. rain or ambient temperatures below 40°F. The Contractor shall take all necessary precautions to prevent any damages caused by the hydraulic pressure of the fill during placement prior to hardening. Also, necessary means to confine the materials within the designated space shall be provided by the Contractor.

During placement of the fill, the Contractor is to avoid construction stoppage that would exceed the working time of the fill. If for any case that the fill would harden, the Contractor is responsible for properly installing fill into the abandoned pipeline from another location and shall meet the requirements specified herein.

A city Engineering Department Representative shall be present to witness the placement of flowable fill in abandoned pipelines. A 48-hour notice shall be given to the city before the placement of fill.

The flowable fill shall be proportioned and placed as specified herein. In general, the strength desired is the maximum hardness that can be excavated at a later date using conventional excavating equipment. No curing protection is required.

The fill shall be left undisturbed until material obtains sufficient strength. Sufficient strength is a minimum of 150 psi penetration resistance as measured using a handheld penetrometer. The penetrometer shall be provided by the Contractor.

All flowable fill areas subjected to traffic loads must have a durable riding surface.

Payment of the applicable lump sum price shall be full compensation for furnishing all labor, materials and equipment necessary and will include, but is not limited to the necessary costs associated with the installation of the flowable fill as shown in the Drawings and as described in the Contract Documents.

307. MATERIAL INDEPENDENT TESTING

The city shall have the right to have an independent testing laboratory select, test, and analyze, at the expense of the city, test specimens of any or all materials to be used. The results of such tests and analyses shall be considered, along with the tests or analyses made by the Contractor, to determine compliance with the applicable specifications for the materials so tested or analyzed. The Contractor hereby understands and accepts that wherever any portion of the work is discovered, as a result of such independent testing or investigation by the city, which fails to meet the requirements of the Contract documents, all costs of such independent inspection and investigation as well as all costs of removal, correction, reconstruction, or repair of any such work shall be borne solely by the Contractor.

400 SERIES: SANITARY SEWER

401. SANITARY MANHOLES

401-1. BUILT UP TYPE

Manholes shall be constructed of brick with cast iron frames and covers as shown on the drawings. Invert channels shall be constructed smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made in a smooth curve of as large a radius as possible. Changes in size and grade of channels shall be made gradually and evenly. Invert channels shall be formed by one of the following methods: formed directly into concrete manhole base, build up with brick and mortar, or lay half tile in concrete. For invert channels formed using the brick and mortar, or the half tile in concrete approaches the entire bench and channel area will be coated with a minimum of one-half inch of Xypex Megamix II or approved equal.

The manhole floor outside of channels shall be made smooth and sloped toward channels. Free drop in manholes from inlet pipe invert to top of floor outside the channels shall not exceed 12 inches (12”).

Standard Drop Manholes shall be constructed wherever free drop exceeds twelve inches (12”). Doghouse manholes and flat top manholes are not permitted. If a drop manhole is needed, only outside drop manholes allowed.

Manhole steps shall not be provided. Joints shall be completely filled with mortar, shall be smoothed from inside of manholes.

The entire interior and exterior of brick manholes shall be plastered with one half inch (1/2”) of Mega Mix II with Bio San as supplied by Xypex or approved equal.

Brick used may be solid only. Brick shall be laid radially with every sixth course being a stretcher course.

Maintenance of Flow Plan:

1. The Contractor shall prepare a Maintenance of Flow Plan that describes in detail the work that will be performed by the Contractor to maintain continuous operation of the city’s existing utility services. Maintenance of Flow Plan shall address the temporary and permanent flow diversion of gravity sewers and service laterals.
2. Temporary diversion of the gravity sewer flows shall be done using bypass pumps (one duty, one standby) to pump from the upstream manhole to the downstream manhole. Bypass pumps shall have hospital grade sound attenuation. The Contractor shall obtain peak wet weather flow rates in the gravity sewer from the city and shall demonstrate in the Maintenance of Flow Plan that adequate pumping capacity is provided to accommodate peak wet weather flow. The Contractor and city personnel that are experienced in the collection system shall determine the float levels in the field, pump on, standby or lag pump on, and high-level alarm. The high-level alarm shall be connected to an auto dialer to notify the Contractor of an alarm condition. The bypass pump suction manhole shall use the collection system for a temporary wet well storage; however, surcharging in the existing sewer system shall be limited. Once the high-level float alarm is triggered, it shall allow enough time for emergency Contractor personnel to arrive on scene and resolve the problem prior to any sanitary sewer overflows. The bypass suction and discharge pipes may require the removal of the manhole tops which will result in excess odor escaping from the manholes. The contractor shall provide a means to seal odors within the bypass manholes to minimize odors during the temporary diversion.
3. The Maintenance of Flow Plan shall include a sequence of construction with projected time, in days, for each step in the sequence.

4. If the work required to maintain utility operation must occur during evening, night or weekend hours, the Contractor shall notify the affected residents in advance of the projected work. The Contractor shall reimburse the city for overtime work, including inspector overtime, in excess of regular working hours. The Contractor must also get permission from city Project Manager before working outside of Noise Ordinance hours.
5. Identify the person(s) responsible for executing the Maintenance of Flow Plan and the systems to be put in place for monitoring the existing utility system's ability to maintain flow.

401-2. PRECAST TYPE

Precast Sanitary Manholes shall conform to this specification unless otherwise approved by the City Engineer.

AASHTO M 85 Type II cement, with Xypex Admix C-1000R or approved equal, shall be used throughout with a minimum wall thickness of five inches (5"). The precast sections shall conform to ASTM C478 (latest edition). Section joints shall be a tongue and groove with "ram neck" gasket, Pro Stik Butyl Sealant or "O" ring to provide a watertight joint. Caulking of joint shall not be allowed. Minimum concrete strength shall be 4000 psi at 28 days. Xypex admixture must be added to the concrete at the time of batching. Under normal conditions, the crystalline powder shall be added to the concrete mix at the following rates:

1. Xypex Admix C-1000R 3.5 % by weight of cement content

Note: For enhanced chemical protection or for meeting specific project requirements or where the concrete mix design contains higher than 25% type F fly ash content or includes a Portland cement/slag cement/type C fly ash blend, consult with manufacturer or its authorized representative to determine appropriate dosage rates.

One set of shop drawings and location inventory shall be submitted to the city Project Manager and Engineer of Record for approval. Approval of shop drawings does not relieve Contractor of responsibility for compliance to these specifications unless letter from Contractor requesting specific variance is approved by the City Engineer.

Location inventory submitted with shop drawing shall detail parts of manhole per manhole as numbered on the construction plans. All manhole parts shall be numbered or lettered before being sent to the job site to permit proper construction placement. A plan or list of the numbering system shall be present on the job site when manhole components are delivered. Precast manhole dimensions, drop entry, grout flow of channel, etc., shall be as shown on city of *Clearwater Engineering Index 302 Sheets*.

Manhole sections shall be rejected if abused during shipping or placement and if pipe openings are not properly aligned. The "break in" to precast manholes for pipe entry will not be allowed. The manhole base shall be set on a pad of A 1 or A 2 Classification compacted soil approximately five inches (5") thick as referenced in *Section 304-2* and twelve inches (12") of # 57 grade stone, wrapped in geotextile to secure proper seating and bearing. Refer to these Technical Specifications, *Section 304* for backfill and compaction requirements.

401-2.1. MANHOLE ADJUSTMENT RINGS (GRADE RINGS)

Between the top of the manhole cone/corbel and the manhole cover frame, a manhole adjustment ring shall be installed. The intent of the manhole adjustment ring is to accommodate future grade changes without disturbing the manhole. See *Section IV, Section 703-7, Asphaltic Concrete – Adjustment of Manholes*. All final grade adjustment of manhole covers, and frame assemblies shall be completed utilizing injection molded high density polyethylene (HDPE) adjustment rings as manufactured by LADTECH, Inc. or an approved equal. The adjustment rings shall be manufactured from polyethylene plastic as identified in ASTM Specification D4976 (Standard Specification for Polyethylene Plastic Molding and Extrusion

Materials) the latest edition. Material properties shall be tested and qualified for usage per the ASTM Test Methods referenced in the above ASTM standard. The adjustment rings shall be molded from 100% recycled material. The plastic rings shall be manufactured utilizing the injection molding process as defined by SPE (Society of Plastic Engineers). The adjustment rings shall be tested to assure compliance with impact and loading requirements per the AASHTO Standard Specification for Highway Bridges latest edition. Installation shall be per manufacture's recommendations for vacuum test installations only. The annular space between the rings and cone basin, the rings, and the rings and cover frame shall be sealed utilizing an approved butyl rope (not caulk) sealant. All adjustment for matching road grade shall be made utilizing a molded and indexed slope ring. All grade rings shall be covered by the LADTECH, Inc. warranty or one of equal terms and duration. Grade rings shall be Traffic Rated AASHTO HS-20 (latest edition).

401-2.2. STAINLESS STEEL MANHOLE STORM WATER INFLOW ABATEMENT INSERTS (DISH/PAN)

401-2.2.1. MATERIALS AND DESIGN

General: The insert, gasket and relief valve shall be manufactured of materials resistant to corrosion from atmospheres containing hydrogen sulfide and dilute sulfuric acid.

Insert: The insert body shall be manufactured of 304 stainless steel with a thickness of not less than 18 gauge. The insert shall have straight sides designed to allow a loose fit into the ring for easy removal. The insert manufacturer must furnish a "load test verification" showing a load test failure in excess of 3000 lbs. For added strength, no less than three (3) ribs shall be stamped in bottom of the insert.

Gasket: The gasket shall be extruded onto the stainless dish with a Synthetic elastomer having the following physical properties:

Tensile Strength: 335 psi - ASTM D412 Elongation 400-600% - ASTM D412 Shore Hardness: 25 Shore A - ASTM D2240 Adhesion to Stainless: 580 psi - ASTM D454 I/D7234 (Use latest edition)

Relief Valve: The gas relief valve shall be designed to release at a pressure of .5 to 1.5 PSI and have a water leak down rate no greater than 5 gallons per 24 hours. The valve shall be installed in the insert by means of a hole tapped in the insert by the manufacturer. The valve shall be made of nitrite for prevention of corrosion from contact with hydrogen sulfide, dilute sulfuric acid and other gases associated with wastewater collections systems.

Handle: The dish shall have a handle of 3/16" plastic-coated stainless-steel cable installed on the body of the dish. The handle shall be attached with a #6 high-grade stainless-steel rivet. The cable shall be braided in a manner which resists cutting with common bolt cutters. The cable terminal and eye shall be stainless steel.

Manhole Frames: Manhole frame sizes vary, and the city will provide the successful bidder with specific dimensions and number of required inserts for each manhole frame size. Maximum insert outside diameter (OD) will not exceed 26.5 inches nor be less than 23 inches. Most frames have an outside diameter of 23.5 inches with a clear opening of 21.5 inches.

401-2.2.2. MEASUREMENT AND PAYMENT

Payment of each inflow abatement insert shall be full compensation for furnishing all labor, materials and equipment necessary but not limited to the costs associated for the installation of the sanitary manholes' pans/dishes.

401-3. DROP MANHOLES

Standard drop inlets to manholes shall be constructed of commercial pipe, fittings, and specials as detailed on the drawings. Only outside drop manholes allowed.

401-4. FRAMES AND COVERS

Manhole frames and covers shall be set in a full bed of mortar with the top of the cover flush with or higher than finished grade as directed. Refer to *Clearwater Standard Detail Index 301*.

401-5. MANHOLE COATINGS

The exterior of all precast manholes shall not require any specific coating. The interior shall be coated with either Spraywall®, Polyurethane or Raven 405 Epoxy at the direction of the city at a thickness not less than 125 mil. For new manholes install geotextile wrap at the joints.

401-6. CONNECTIONS TO MANHOLES

Connections to existing sanitary manholes using approved PVC sewer main shall be made with a manhole adapter coupling by NPC Kor-N-Seal® with stainless steel bands or approved equal water stop coupling.

401-7. MEASUREMENT AND PAYMENT

Payment of each inflow abatement insert shall be full compensation for furnishing all labor, materials, and equipment necessary but not limited to the costs associated for the installation of the sanitary manholes.

402. RAISING OR LOWERING OF SANITARY SEWER STRUCTURES

Sanitary Sewer Structures shall be raised or lowered as indicated on the plans or as indicated by the Engineer.

402-1. BASIS OF PAYMENT

Payment, unless covered by a bid item, shall be included in the cost of the work.

403. SANITARY SEWERS AND FORCE MAINS

403-1. MATERIALS

403-1.1. GRAVITY SEWER PIPE

GRAVITY SEWER PIPE SHALL BE POLYVINYL CHLORIDE OR DUCTILE IRON. All polyvinyl chloride mains (pipe and fittings) shall be at least 6-inch-diameter, SDR 26, and conform to ASTM D3034; laterals can be four-inch (4'') PVC schedule 40. Pipe and fittings shall be plainly marked with the ASTM designation. Strong back stainless steel Fernco is required for all non-mechanical PVC connections. The bell end of joints and fittings shall have a rubber sealing ring to provide a tight flexible seal in conformance with ASTM D3212 (latest edition). The laying length of pipe joints shall be a maximum of twenty feet (20').

Unless otherwise noted in these specifications or the construction plans, ductile iron pipe and fittings for gravity sewer shall conform to *Section 502-2.1* of these Technical Specifications for DIP water main except the pipe interior shall be lined with Protecto 401 ceramic epoxy in accordance with manufacturer's recommendations. Where sanitary sewer main is to be placed between buildings lots in a sideline easement, the sewer main shall, insofar as possible, be constructed without manholes or lateral connections within the side easement. A two-way cleanout shall be installed on each lateral at the property line.

403-1.2. FORCE MAIN PIPE

FORCE MAIN PIPE SHALL BE POLYVINYL CHLORIDE, DUCTILE IRON OR HDPE. Unless otherwise noted in the specifications or construction plans, polyvinyl chloride, ductile iron and HDPE force main pipe and fittings shall conform to *Section 502-2.1* and *502-2.2* of these Technical Specifications for water main pipe except that DIP shall be lined with Protecto 401 ceramic epoxy in accordance with manufacturer's recommendations. All polyvinyl chloride pipe which has become deteriorated due to exposure to ultraviolet radiation shall be rejected.

403-2. INSTALLATION

403-2.1. GRAVITY SEWER PIPE

Installation of Thermoplastic gravity sewer pipe shall be in conformance with recommended practices contained in ASTM D2321 (latest edition).

The bottom trench width in an unsupported trench shall be limited to the minimum practicable width (typically pipe OD plus eight inches (8") to twelve inches (12") on each side) allowing working space to place and compact the haunching material. The use of trench boxes and movable sheeting shall be performed in such a manner that removal, backfill and compaction will not disturb compacted haunching material or pipe alignment.

Dewatering of the trench bottom shall be accomplished using adequate means to allow preparation of bedding, placement of the haunching material and placement of the pipe in the trench without standing water. Dewatering shall continue until sufficient backfill is placed above the pipe to prevent flotation or misalignment.

Where pipe bedding is insufficient to adequately support the pipe, the Contractor will be required to remove unsuitable material and pipe bedding and replace with Class I material (one half inch (1/2") diameter aggregate) to provide firm support of the pipe.

The laterals shown on the plans do not necessarily reflect exact locations. The Contractor is required to locate all existing laterals for reconnection and to coordinate with the construction inspector, the location of all new laterals.

403-2.2. FORCE MAIN PIPE

Installation of force main pipe shall be in conformance with *Section 503* of these Technical Specifications for water main pipe.

403-3. INSPECTIONS OF LINES AND MANHOLES

- A. Inspection of completed lines and manholes shall be scheduled within a reasonable time after construction or when required by the Engineer. Before scheduling an inspection, the Contractor shall prepare the lines by cleaning and flushing. Manholes shall be clean, finished, and free of leaks.
- B. Manholes shall be on a true and uniform grade. The inverts shall have a smooth steel troweled finish. All benches shall be uniformly sloping. The frames shall be tight and properly set in mortar

on solid masonry. The invert, benches and adjacent pipe shall be free of splattered mortar. All required interior lining or paint shall be kept intact. Manhole frames shall be adjusted to grade with the covers and frames cleaned and free of mortar and asphaltic mixtures. All precast manhole seams shall be filled with an approved asphaltic compound.

- C. Pipe between manholes shall be true to line and grade. Dips and sags with one inch or more of trapped water shall be cause for rejection. Air testing may be required also at the Contractor's expense. Contractor shall provide personnel to assist with inspections.
- D. The Contractor shall provide city Public Utilities Department and the Engineer with a Television Inspection of the completed gravity sewers in accordance with the following:
 - 1. Shall be performed by a National Association of Sewer Service Companies (NASSCO) Pipeline Assessment & Certification Program (PACP) Certified Operator who will use software that is compatible with CUES Granite products latest version software to NASSCO PACP Standards.
 - 2. Shall be submitted as digital media that includes video and data base file in PACP format and include a printed copy of the PACP television inspection log.
 - 3. Shall perform a manhole inspection and provide a completed NASSCO Manhole Inspection form (latest version) for each manhole that is inspected
 - 4. All pertinent data recorded in audio on the media to include:
 - a. Subdivision name and phase number.
 - b. Manhole numbers (these numbers must match manhole numbers on “as built” and record drawings).
 - c. Date of inspection
 - d. Size and material of pipe
 - e. Service connection locations, right or left
 - f. All distances between manholes
 - g. Locations of suspected and obvious pipe deficiencies (i.e., bad joints, breaks or leaks, etc.)
 - 5. PVC pipe shall have a deflection test using a seven and one-half percent (go-no-go) test mandrel of appropriate size, which shall be visible on video at all times.
 - 6. The printed NASSCO PACP television report (indicating manhole numbers) which will accompany the media. This written report must include:
 - a. Manhole numbers (these numbers must match manhole numbers on "as-built" and record drawings).
 - b. Service connection locations, right or left.
 - c. Reference to service connection locations out of manholes.
 - d. Locations of suspected and obvious pipe deficiencies (i.e., bad joints, breaks or leaks, etc.).
 - e. Depth of each manhole.
 - f. Actual measured distance (on ground) between manholes.
 - 7. All visual and television inspections shall be completed by the contractor and approved by city Public Utilities Department and Engineer after the road base has been constructed but prior to the placing of any asphalt.
 - 8. Television Inspection Media must clearly show details of structural defects, misalignments and infiltration.

403-4. TESTING

403-4.1. TESTING OF GRAVITY SEWERS

The Contractor shall take all precautions to secure a perfectly watertight sewer under all conditions. The water tightness of a sewer which has a crown lying below groundwater level shall be tested by measuring infiltration. The water tightness of sewers having crowns lying above groundwater level shall be tested by filling the pipe with water so as to produce a hydrostatic head of two feet or more above the crown of the sewer at the upper end of the test section or the water table outside of the sewer, whichever is higher, and then measuring the exfiltration. In no case shall the infiltration or exfiltration exceed fifty (50) gallons per inch of diameter per mile per day. The Contractor shall furnish all labor, materials and equipment to test the amount of infiltration or exfiltration under the Engineer's direction. Where the infiltration or exfiltration is excessive, the Contractor at their own expense shall take the necessary steps to remedy such conditions by uncovering the sewer, remaking the joints or by replacing the entire length of sewer as required by the Engineer. No such repaired joints may be backfilled until after they have been tested and found to be acceptable. Care shall be taken to avoid flotation. The Contractor shall TV inspect all mains and provide to the Engineer to verify the true and uniform grade and the absence of bellies or dropped joints prior to acceptance. Any dips or sags of more than five percent (5%) of the pipe inside diameter (ID) dimension from its design alignment shall be cause for rejection. The above tests shall be performed at the discretion of the Engineer on any or all sections of the line.

403-4.2. TESTING OF FORCE MAINS

Force mains shall be tested under a hydrostatic pressure of 150 psi for two (2) hours, as described in Section 504 of these Technical Specifications for the testing of water mains.

403-5. BASIS OF PAYMENT

403-5.1. GRAVITY SEWER PIPE

Payment for in place sanitary sewer gravity main pipe shall be the unit price per linear foot per appropriate range of depth of cut as contained in the contract bid. Measurement for payment shall be along the centerline of the sewer main from center to center of manholes. Payment for laterals shall be the unit price per linear foot of pipe as measured from the centerline of the sewer main pipe to the terminal end of the lateral pipe including a two-way cleanout at the property line.

Payment for sewer pipe shall include all labor, equipment, and materials necessary to complete the installation. This shall include clearing and grubbing, excavation, shoring and dewatering, backfill and grading.

403-5.2. FORCE MAIN PIPE PAYMENT

Payment and measurement of force main pipe shall be the same as described in *Section 506* of these Technical Specifications for water main pipe.

404. CURED-IN-PLACE PIPE SANITARY SEWER REHABILITATION

404-1. GENERAL

It is the intention of this specification to provide for the trenchless restoration of sanitary sewers, mains and service laterals, by the installation and curing of a resin impregnated felt tube/cured-in-place pipe (CIPP) liner. The liner shall be jointless, continuous from manhole to manhole, watertight and chemically resistant to withstand exposure to domestic sewage. Installation and curing shall include all labor, materials and equipment to provide for a complete, fully restored and functioning installation. Any proposed installer/contractor, or liner system, must be pre-approved by the city prior to receiving bids.

The installer must be certified by the liner system manufacturer for installation of the liner system. The city reserves full and complete authority to approve the satisfactory nature of the both the liner system and the installer.

The contractor shall provide trenchless reconstruction of service laterals and mainline sewers. The contractor shall have the capability of performing city's selected services which include televised inspection, data collection, system flow analysis, and pipeline reconstruction.

The contractor shall employ adequate staff to perform the services required, staff should include Project Representative, Project Manager, Field Supervisor and Senior Foreman. Field supervisory personnel employed by the CIPP Contractor will have at least five (5) years of experience in the performance of the work and tasks as stated in the Contract Documents.

Staff shall be proficient and experienced in all phases of services mentioned.

The contractor shall perform all work and shall be a licensed Contractor for these services.

The contractor shall be certified in confined space entry (OSHA) and traffic control.

The contractor shall provide services that include safety measures for both the public and workers, including traffic control, and shall coordinate all scheduling with the city.

The contractor shall work with the city in establishing priorities and in preparing work assignments.

The contractor shall be completely responsible for the control of the environment of the work site during on-site operations. All precautions shall be taken by the selected contractor to protect the workers, public and city staff from the exposure to harmful or hazardous substances with the sewer system.

The contractor shall be responsible for the transport and disposal of all waste materials. The selected contractor shall be responsible for all waste material spills and clean-up in the loading, hauling, and unloading of the contractor's equipment.

The contractor shall be responsible for conforming to any and all requirements regarding hauling and disposal of sewer wastes from each city's work site in accordance with OSHA regulations and those that may be mandated by the Federal or State Governments. The contractor shall ensure that all waste material transporters possess all required local, state and federal transportation permits and that they comply with all local, state and federal regulations, including but without limitation, 40 CFR Part 263, "Standards Applicable to Transporters of Hazardous Wastes" and Chapter 17-730, Part 3, Florida Administrative Code, as may be amended from time to time.

The contractor shall inform the city of its planned work schedules and shall afford the city reasonable opportunity to observe and inspect the contractor's work in process. The city will be advised of all schedule changes and notified when a work site is left for a 24-hour period when work is not complete.

The contractor shall report to city's Inspector their daily progress.

Work hours shall be from 7:00 AM to 3:30 PM Monday through Friday unless authorized in writing by the city's Project Manager.

404-2. MEASUREMENT & PAYMENT

Payment for sanitary sewer rehabilitation using the cured-in-place product shall be made per linear foot including all preparation, installation, curing, flow maintenance, lateral reconnection, submittals, light cleaning (3 passes of cleaning head) of piping, material removal & disposal, CCTV inspection/reporting (pre & post installation) sealing of all leaks, connection to all manholes, traffic control on city streets, testing such as infiltration and/or exfiltration, provision of equipment, labor, materials, operations, restoration, etc., to provide a fully completed and operational sewer.

Payment shall be measured from center of manhole to center of manhole for the sanitary sewer mains and from the connection to the main to the terminus of the liner for service laterals.

404-3. SUBMITTALS

The Contractor shall submit the following information:

1. Manufacturer's certification that the materials to be used meet the referenced standards and these specifications.
2. License or certificate verifying Manufacturer's/Licenser's approval of the installer.
3. Proposed equipment and procedures for accomplishing the work.
4. Lining Manufacturer's product data and instructions for resin and catalyst system.
5. Design Calculations, in accordance with the Appendix of ASTM F1216 or latest edition, for each length of liner to be installed including the thickness of each proposed CIPP. It will be acceptable for the Contractor to submit a design for the most severe line condition and apply that design to all of the line sections. To be completed and certified by a Professional Engineer proficient in the design of pipeline systems. All calculations shall include data that conforms to the requirements of these specifications.
6. A detailed installation plan describing all preparation work, cleaning operation, pre-closed-circuit television (CCTV) inspections, flow maintenance, traffic control, installation procedure, method of curing, service reconnection, quality control, testing to be performed, final CCTV inspection, and all else necessary and appropriate for a complete CIPP liner installation.
7. Tube wet-out and cure method including: a complete description of the proposed wet-out procedure, manufacturer's recommended cure method- for each diameter and thickness of CIPP liner to be installed, and detailed curing procedure detailing the curing medium and the method of application.
8. A detailed installation schedules.
9. All SDS sheets for all materials to be furnished for the project.
10. Weekly work schedules shall be submitted no later than close of business on proceeding Thursdays for the work on the following week. Scope of the schedule shall include the following: cleaning operations, CCTV pre & post operations, lining, and crew leader's information including phone number.

404-4. CURED-IN-PLACE PIPE (CIPP) FOR GRAVITY SEWER MAINS

404-4.1. LINER MATERIAL

The liner material shall be an epoxy, vinyl ester or polyester fiber felt resin-impregnated tubing or city Engineering Department approved equal, sized to tightly fit the internal circumference and length of the designated gravity sewer. The cured liner shall meet the minimum initial structural properties as listed in ASTM F1216. The liner shall be designed in accordance with the Appendices in ASTM F1216. It shall be assumed that a fully deteriorated gravity sewer pipeline having no structural strength will be rehabilitated with H-20 traffic loading, the water table's at the ground surface and the product installed will have a minimum expected lifetime of fifty (50) years. In no case shall the liner thickness be less than six millimeters (6 mm) for pipe sizes six inches (6'') through eight inches (8'') and 7.5 millimeters for pipe sizes ten inches (10'') through twelve inches (12'') in diameter. Minimum liner thickness for pipes greater than twelve inches (12'') shall be as specified by the city. Liner shall be sized by Contractor to provide a tight fit to the inside circumference of the host pipe and shall be a continuous jointless lining from manhole to manhole.

Unless otherwise specified, the Contractor shall use an epoxy vinyl ester or polyester resin and catalyst system, and a fiber felt tube compatible with the inversion or other approved alternate installation process and having the following minimum physical properties for the cured pipe:

PROPERTY VALUE	TEST METHOD	MINIMUM (psi)
Tensile Strength	ASTM D638 or latest edition	3,000
Flexural Strength	Modified ASTM D790 or latest edition	4,500
Flexural Modulus of Elasticity	Modified ASTM D790	250,000
Long-Term (50 year) Modulus of Elasticity	ASTM D7790 or latest edition	125,000

The epoxy vinyl ester or polyester resin and fiber felt tubing system shall be in accordance with the requirements of ASTM F1216 and be fabricated to a size that, when installed, will neatly fit the interior of the host pipe. Allowance shall be made for circumferential stretching during a direct (non-inversion) pull in. The CIPP product shall fit tightly to the host sewer pipe (with minimal shrinkage) in such a way as to minimize water migration (tracking) between the liner and the host pipe. A vacuum impregnation process shall be used in conjunction with a roller system to achieve a uniform distribution of the resin throughout the tube under controlled conditions. The volume shall be adjusted by adding five to ten (10) percent excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into cracks or joints in the host pipe.

The outside of the fabric tube shall be marked every 5 feet with the name of the manufacturer or CIPP system, manufacturing lot and production footage.

404-4.2. CHEMICAL JOINT, CRACK AND ANNULAR SPACE SEALING MATERIALS FOR ACTIVE LEAKS AND SERVICE LATERAL CONNECTIONS

Chemical joint and crack sealing materials shall have the following properties:

1. React quickly to form a permanent watertight seal
2. Resultant seal shall be flexible and immune to the effects of wet/dry cycles
3. Non-biodegradable and immune to the effects of acids, alkalis, and organics in sewage
4. Component packaging and mixing compatible with field conditions and worker safety

5. Extraneous sealant left inside pipe shall be readily removable; and shall be compatible with the repair resin utilized.

Chemical joint sealing material shall be acrylic resin type and shall be furnished with activators, initiators, inhibitors, and any other materials recommended by the manufacturer for a complete grout system. Sealing grout shall be furnished in liquid form in standard manufacturer's containers.

404-4.3. MANHOLE CONNECTIONS

A seal, consisting of a resin mixture or hydrophilic seal compatible with the installed CIPP shall be applied at manhole walls in accordance with the CIPP System manufacturer's recommendation. Cost associated with manhole seals shall be included in the contract price of CIPP installation.

404-4.4. INSTALLATION AND EXECUTION

404-4.4.1. CLEANING/SURFACE PREPARATION

It shall be the responsibility of the Contractor to clean and prepare the existing pipes for rehabilitation. The Contractor shall perform light cleaning (3 passes of the jet head) using a jetting system capable of providing 60 gallons of flow at 3,000 psi. After light cleaning has been completed the Contractor shall attempt a pre-installation CCTV inspection. If the Contractor believes that the piping requires additional cleaning the collected CCTV video will be provided to the Inspector before beginning any heavy cleaning of the piping. Light cleaning is included in the cost of liner installation and heavy cleaning will be measured as a separate pay item. The Contractor will thoroughly clean the interior of the sewers to produce a clean interior surface free of all coatings, sand, rock, roots, sludge, or other deleterious materials prior to liner insertion. Flow maintenance will be provided by the Contractor as required. Bypass operations are to be so arranged as to cause minimum disruptions to local traffic, residents and commercial facilities. During the cleaning and preparation operations all necessary precautions shall be taken to protect the public, all property and the sanitary sewer facilities from damage.

All material removed from the sewers shall be the Contractor's responsibility for prompt disposal in accordance with all regulatory agency requirements. The Contractor may be required to control the rate of sewer cleaning in the sanitary system to avoid heavy pollution loads at the city's treatment plants.

404-4.4.2. TELEVISION INSPECTION

After cleaning, and again after the rehabilitation work on each section of pipe is completed, all pipe sections shall be visually inspected with a digital CCTV camera and recorded in DVD format. Cost of CCTV inspections is included in the cost of pipe lining CCTV data shall be provided to the city designated Project Manager. Asset Management (OWAM) software. This section describes the requirements of the Contractor in providing the following minimum requirements for video capture, photo capture and database structure to the city. The city is currently using CUES Granite video and data collection software. The Contractor shall provide the TV Inspections in the same CUES Granite product database, photo, and video capture format. The Contractor-provided TV inspections, database, DVDs, photos, and related files shall have the ability to direct synchronize to the city's existing CUES Granite product database.

404-4.4.2.1. IMAGE (PHOTOS) CAPTURE FORMAT AND REQUIREMENTS

The Inspection image files (pictures) shall have the ability to export to industry standard formats to include JPEG, BMP, and TIFF formats and be transferable by disk, thumb drive, DVD and/or external hard drive to an external personal computer utilizing standard viewers and printers.

404-4.4.2.2. DIGITAL VIDEO FORMAT AND REQUIREMENTS

Digital video files (Inspection Videos) shall be captured and/or recorded in the MPEG format or as specified by the city. The video capture files shall be in MPEG format with data linking (Inspection Observations) to the database file(s). The “Link” of the video capture file to the database observation file is required. The inspection observation(s) shall link to the video record in real-time.

The accompanying database shall support the following code system: PACP, or current code system being utilized by the city. The Database and Software program (CUES Granite products) shall be able to import asset data from an Esri ArcGIS (v.10.1+) geodatabase utilizing the network features to associate Sewer Mains with corresponding Sewer Nodes.

The database structure shall retain information on the various structures found within a sewer or storm system. It is important that the structures, nodes, manholes and pipe identifiers and related attribute information be retained as separate tables from the inspection allowing import of existing data from multiple sources. The data structure allows different projects to reside within a single database. Information gathered in projects shall be available to view by project or by system. Data gathered during project inspection shall be available to view by the selected structure. Therefore, all inspections can be viewed on a structure even if gathered in different projects.

404-4.4.2.3. SYNCHRONIZATION

The database shall have the ability to synchronize assets and inspections from replicated databases. The synchronization process should have built-in error checking for duplicates, updates and any modifications to the data being synched. This allows for multiple sources of data to be effectively consolidated into a single unitary database for analysis and evaluation.

404-4.4.3. LINER INSTALLATION

Liner shall be sized to field measurements obtained by the Contractor to provide a tight fit to the full interior circumference of the existing sanitary sewer and shall be a continuous, joint-less liner product from inside of manhole to inside of manhole. Contractor shall use installation methods approved by the liner manufacturer including liner placement, reforming to fit existing pipe, pressure and heat requirements and reconnection of laterals. The Contractor shall immediately notify the city of any construction delays taking place during the insertion operation. Contractor shall provide flow maintenance measures as described by the approved Flow Maintenance Plan. Flow Maintenance Plan shall be approved by the city Project Manager prior to 48-hours of mobilization. Flow Maintenance Plan shall include redundancy. Liner entries at manholes shall be smooth, free of irregularities, and watertight. No pinholes, tears, cracks, thin spots, or other defects in the liner shall be permitted. Such defects shall be removed and replaced by the Contractor at their expense. OSHA requirements for installation procedures, in particular, confined spaces are to be met.

404-4.4.4. LATERAL RECONNECTION

Sanitary laterals shall be reconnected as soon as possible to renew service. Laterals are to be reconnected by means of robotics, by internally cutting out the liner to 100% of the area of the original opening. All lateral reconnections are to be grouted, as directed by the city to prevent leakage. Grouting method and material is to be approved by the city. Cost for robotic reconnection shall be included in the cost to install the liner. If the city wishes to reconnect service lateral using a different method the cost to do so will be measured and paid for separately.

Any reconnections to laterals and connections to manholes which are observed to leak shall be resealed by the Contractor. All laterals discovered during the lining process are to be reconnected unless specifically directed otherwise by the city. Contractor shall notify all local system users when the sanitary system will not be available for normal usage by the delivery of door hangers seven days before commencement with

appropriate information regarding the construction project. Contractor shall notify the Senior Public Information Coordinator from the city Public Communications Department prior to distribution.

404-4.4.5. TIME OF CONSTRUCTION

Construction schedules will be submitted by the Contractor and approved by the city. At no time will any sanitary sewer service connection remain inoperative for more than an eight (8) hour period without a service bypass being operated by the Contractor. In the event that sewage backup occurs and enters buildings, the Contractor shall be responsible for cleanup, repair and property damage costs and claims.

404-4.4.6. TESTING AND ACCEPTANCE

Post cleaning and television inspection shall proceed only after all necessary work and preparation has been completed, including the following:

- Placement of traffic control measures in accordance with these specifications
- Implementation of adequate flow control
- Pre-installation cleaning and television inspection
- Installation of CIPP liner in accordance with specifications
- All services re-instated including grout sealing in accordance with these specifications

The Contractor shall clean and televise the assigned gravity sewer in accordance with *Sections 404-4.4.1, 404-4.4.2, 404-4.4.2.1, 404-4.4.2.2 and 404-4.4.2.3*. The interior surface of the pipeline shall be cleaned with high pressure water jet equipment immediately prior to conducting the post television inspection. Jetting equipment will provide a minimum of sixty (60) gallons per minute of water at 3,000 psi. All service locations, gouges, cracks, bumps, bulges and obstructions, such as dropped joints, shall be noted on the inspection. In the case of bellies in the line, the pipe shall be cleared of any standing water to provide continuous visibility during the post inspection. The Contractor shall provide all inspections in digital PACP format including printed inspection logs to the city. Cost associated with post-televising and cleaning shall be included in the contract price of CIPP installation.

The finished liner shall be free of significant visual defects, damage, deflection, holes, leaks and other defects.

Each individual pipe segment contained in a development is to be considered an “individual project” such that all work, including all deliverables shall be reviewed and accepted prior to the city accepting and processing payment for that individual project. No partial payments will be made on individual sewer projects.

404-4.4.7. CLEANUP

Cleanup is an essential part of the work. As the work progresses and is completed, the Contractor shall clean the various sites of all operations and completely restore all work areas to the satisfaction of the city. This cleanup shall be done as promptly as practicable and shall not be left until the end of the construction period. No part of the work shall be considered complete and no payment will be made until cleanup is completed.

404-5. CURED-IN-PLACE PIPE (CIPP) FOR SERVICE LATERALS

404-5.1. LINER MATERIAL

The lining material shall be a fiberglass/polyester needle fleece vacuum epoxy resin -impregnated or equivalent material tube, matching the diameter of the lateral pipe, which is inserted into the service lateral to be rehabilitated and cured-in-place by an acceptable curing method. No Polyester resins will be accepted.

The epoxy shall be suitable for the design conditions as well as the curing process. The cured liner shall provide a service life of 50 years and shall have the minimum structural properties listed below:

PROPERTY VALUE	TEST METHOD	MINIMUM (psi)
Tensile Strength	ASTM D638	3,000
Flexural Strength	Modified ASTM D790	4,500
Modulus of Elasticity	ASTM D790	250,000

The liner system shall consist of a sectional liner in the mainline (full wrap around the circumference of the main line extending 5” on either side of the service) and the continuous lateral liner shall have the capacity to extend to within 10 feet of the building foundation. The liner shall form a continuous, one-piece, tight fitting, corrosion resistant and verifiable non-leaking cured in place pipe. The one-piece section liner shall be manufactured in a factory setting prior to its arrival on site. No component of the liner (i.e. lateral tube to mainline piece) shall be glued or sewn fused in the field prior to installation. The material shall be capable of conforming to offset joints, bells, and disfigured pipe sections.

The liner shall be designed, fabricated, and installed for the actual conditions encountered for this application including the material of the host pipe, in accordance with the applicable provisions of ASTM F1216 (latest edition), and shall meet the following minimum design conditions: AASHTO H-20 live load with one truck passing; Soil Weight 120 pounds per cubic foot. Coefficient of friction $Ku=0.130$; Groundwater: At the ground surface; fully deteriorated pipe with 2 percent (min.) ovality. If ovality of existing pipe is found to be worse, use actual percent up to 5 percent (max.); Soil Modulus 1,000 psi; Factor of Safety = 2; Soil Depth: Depth of Cover will be determined by field measurements.

The liner shall be designed to withstand all imposed loads, including live loads and, if applicable hydrostatic pressure. The liner shall have sufficient wall thickness to withstand all anticipated external pressures and loads that may be imposed after installation. The design shall be performed and certified by a professional engineer licensed by the Florida.

The liner and resin shall be manufactured by Trelleborg Pipe Seals, BLD, Inc., LMK, Inc., or approved equal. The finished liner product shall be chemically resistant to domestic sewage over the expected lifetime of the rehabilitated pipe.

The lateral liner system shall create epoxy resin migration into the defect/joints of the existing lateral. A combination of mechanical and chemical bonding shall be created between the lateral lining system and existing host pipe.

404-5.2. EPOXY RESIN MATERIAL

The epoxy system shall meet the requirements of ASTM F1216 (latest edition), Section 5.2. The epoxy installed liner system shall produce a liner that will comply with the structural requirements specified herein and shall provide chemical resistance for the flow media in the gravity pipe. The epoxy shall be compatible with the rehabilitation process, shall be able to cure in the presence or absence of water, and shall have an initiation temperature for cure as recommended by the epoxy manufacturer. Polyester and Vinylester resins contain styrene and volatile organic compounds which are susceptible to shrinkage and UV Curing will not be accepted.

Submitted documentation from the epoxy manufacturer specifically describing the chemical characteristics of the epoxy system, including allowable mixing, impregnation, and handling time, transportation and storage time, and recommended curing cycle including temperatures, pressures, and times. The epoxy manufacturer's documentation must also include maximum allowable time for handling the impregnated tube prior to insertion and the maximum allowable elapsed time from insertion to exotherm. If remedial measures are available to extend either of the maximum allowable times indicated above, without affecting the physical properties of the epoxy, the epoxy manufacturer should describe these measures and the time limits beyond which even these measures will not prevent alteration of the physical properties of the epoxy.

404-5.3. INSTALLATION AND EXECUTION

The Contractor, when required, shall provide for the flow of sewage around the section(s) of main pipe where the service lateral designated for lining is located. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. Contractor must coordinate installation with property owner(s).

Delivery, storage, and handling of approved products are the responsibility of the Contractor. The Contractor shall keep them safe from damage and stored with the proper environmental containment as outlined by the manufacturer. No products should be used that have exceeded the designated shelf life as outlined by the manufacturer. Remove damaged products from site. Promptly replace damaged products with new products at no additional cost to the city.

If the service lateral lining process requires the installation of a cleanout, the city must approve the work before it is done.

404-5.3.1. PRE-LINING INSPECTION

Prior to inspecting each service lateral the piping will be cleaned to allow passage of the camera. A recorded CCTV video survey must be completed on the sewer main and service laterals with a pan and tilt camera. The inspection shall confirm the location and clock reference of the lateral junctions to be lined, any offsets within the mainline or service lateral, any intrusion from the lateral into the main; the angle at which the connection comes in; any changes in angle of approach of the lateral for the length of the repair; the potential flows coming through the lateral pipe; the potential flows going through the sewer main pipe; the diametric size of the connection for the length of the liner; the size of the main pipe at the point of the liner and the presence of active infiltration within the vicinity of the work area. Cost to complete the necessary pipe cleaning and CCTV inspection will be included in the cost to install the lateral liner.

Two copies of the pre-lining inspection shall be submitted to the Public Utilities Dept. The Contractor shall be responsible for having a copy of the pre-lining inspections in the field as well. Immediately prior to liner insertion, the camera shall traverse the lateral to inspect for debris which may have entered the line after the existing condition video recording.

404-5.3.2. LATERAL PREPARATION

It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, roots, or broken pipe that will prevent the insertion of the liner. A high speed rotating hydraulic cutter shall be used to cut roots, grease or other obstructions in the pipe. The cut shall be made flush with the wall of the pipe to be restored, and the debris shall be pushed down the lateral pipe to the main pipe and to the downstream manhole and is to be removed by the contractor. If inspection reveals an obstruction that cannot be removed by conventional cleaning equipment, the Contractor shall notify the city and the cleaning effort shall be abandoned. The Contractor shall confirm that the sewer is clean enough to ensure an effective lining. The line segment shall not be lined until approved by the city.

Built-up deposits on the sewer main and lateral pipe walls shall be removed. The removal shall reach at least one foot beyond the liner product to allow the bladder to inflate tightly against the pipe walls ensuring a smooth transition from the liner product to the existing pipe wall.

Where the sewer main pipe has been lined previously with a CIPP liner, a check should be made to ensure the prior lateral reopening work created a lateral opening that is flush with the lateral pipe. If this is not the case, the mainline CIPP must be trimmed back using a lateral cutter.

Where active infiltration is present and when it is recommended by the liner manufacturer the infiltration must be stopped in advance by grouting.

404-5.3.3. LINER INSTALLATION

Notify all property owners not identified for service flow maintenance that their sewage service will be discontinued while the liner is being installed. Notify each affected property owner at least 7 days in advance of commencement of the work, giving the date, start time and time when service will be completely restored. Also provide a telephone number which property owners can call for information during the work.

If required for flow maintenance for selected services, Contractor shall excavate at the property line down to the service lateral for the installation of a cleanout. The preferred method of excavation shall be vacuum excavation. Although other installation techniques may be accepted, they must be pre-approved by the city. The service lateral shall be thoroughly cleaned prior to attaching the PVC wye connection. The riser pipe shall be sealed with a screw type plug, the excavation backfilled with sand or pea gravel, and the surface restored to preconstruction conditions.

Service lateral liner material shall be vacuum impregnated on site with the epoxy resin immediately prior to installation. Impregnation should be carried out under vacuum using electric impregnation table with pinch rollers set at the correct gap as per the manufacturer's instructions. Impregnation should take place in a clean, temperature-controlled cab in which the materials are protected from direct sunlight, objects which may damage the coating.

Impregnation should not take place using a manual roller in which the material is subject to excessive pressure and that the materials are squeezed resulting in a resin slug. All the calculated resin shall be confined to the liner to ensure the correct mechanical properties can be achieved.

Impregnation should not take place outside in an uncontrolled environment in which the materials are exposed to the elements. The liner should not be placed on the ground where it is susceptible to damage from objects such as stones, grit, glass etc. During and upon completion of the impregnation process the liner should be stored in a container to avoid damage prior to loading the material into the installation device.

The liner product shall be loaded inside a pressure apparatus above ground. The pressure apparatus, with an end attached to a robotic manipulator device, shall be positioned in the mainline pipe at the service connection that is to be rehabilitated. The robotic device together with a television camera will be used to align the repair product with the service connection opening. The robotic device shall hold the collar in place while air pressure, supplied to the pressure apparatus through a hose, shall be used to invert the liner into the lateral pipe. The insertion pressure will be adjusted to fully deploy the liner product into the lateral connection and hold the liner product tight to the main and lateral pipe walls.

After insertion is completed, recommended pressure must be maintained on the impregnated liner product for the duration of the curing process. The Contractor shall apply a heat source and circulation system to affect a cure of the epoxy system. The equipment shall be capable of uniformly raising the temperature of the pressurized fluid above the temperature required to affect a complete curing of the epoxy system. Initial cure shall be deemed to be completed when the temperature gauge on the heat source indicates that the temperature inside the tube is of a magnitude to realize an exotherm. The minimum cure period shall be as recommended by the system manufacturer.

The finished liner product shall be free of dry spots, lifts, delamination, and excess epoxy. The installed liner product should not inhibit the post installation video inspection, using a closed-circuit television camera, of the mainline and service lateral pipes or future pipe cleaning operations. During the warranty period any defects with the liner product that affect the performance or cleaning of the lateral connection shall be repaired at the contractor's expense in a manner acceptable to the city.

The Contractor shall inform the city of service laterals in which a liner product cannot be installed due to pre-existing conditions. These services will be identified, documented, video recorded, and the city will be

informed of the conditions encountered. The Contractor will not attempt to install a liner product in these services unless directed by the city.

Contractor may be permitted, at the direction of the city, to install service liners from inside the existing cleanout location to the main line sewer if conditions allow. Final liner product must include a lateral connection repair brim type liner to seal the connection at the host pipe and overlap the service liner installed from the cleanout.

404-5.3.4. TESTING AND ACCEPTANCE

Following installation of the service lateral liners, conduct a final, video recorded, CCTV/color television inspection of the completed work including the service lateral connections at the sewer main and the full length of all service laterals lined during the progress of the work. Copies of these recordings and those made prior to the liner installation shall be submitted to the city for approval and shall be retained by the city. Field acceptance of the liner shall be based on the city's evaluation of the installation including CCTV inspection video recordings and a review of certified test data for the installed pipe samples. groundwater infiltration of the liner shall be zero. There shall be no evidence of splits, cracks, breaks, lifts, kinks, delamination or crazing in the liner. If any defective liner is discovered after it has been installed, it shall be removed and replaced with either a sound liner or a new pipe at no additional cost to the city. The cost for all necessary testing shall be included in the cost associated with the lining.

The Contractor shall clean up each project area after the work is completed and all testing is accepted. Remove and dispose of all excess materials and debris at each location as directed by the city.

405. SANITARY MANHOLE LINER RESTORATION

405-1. SCOPE AND INTENT

It is the intent of this portion of the specification to provide for the repair, rehabilitation and groundwater infiltration abatement of manhole walls, corbels/cones, pipe connections and bench and channel/trough areas. All manhole rehabilitation products will be installed in accordance with the manufacturer's recommendations and these specifications. The purpose of the rehabilitation work is to eliminate inflow and infiltration, provide corrosion protection, and to restore the structural integrity of the manhole. For any particular system the Contractor will submit manufacturer's technical data and application instructions. All OSHA regulations shall be met in the completion of the work and the contractor shall be responsible for all necessary maintenance of traffic. The contractor shall warrant all work against defects in materials and workmanship for a period of one 1 years, unless otherwise noted, from the date of final acceptance of the project. Contractor shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship which may develop during said one year period, and any damage to other work caused by such defects or the repairing of same, at his own expense and without cost to the city.

The following lists all elements of potential rehabilitation activity:

1. REMOVE STEPS
2. STOP ACTIVE INFILTRATION.
3. PATCH VOIDS AND ALL FRAME CONNECTIONS WITH NON-SHRINK GROUT.
4. REMOVE LOOSE COATING MATERIALS.
5. RESURFACE CORBEL/WALLS WITH CEMENTITIOUS MORTAR.
6. REBUILD/REPAIR BENCH & CHANNEL/TROUGH/SEAL PIPE CONNECTIONS.
7. COAT CORBEL/CONE, WALLS, BENCH AND TROUGH WITH AN APPROVED CEMENTITIOUS, EPOXY, OR POLYURATHANE, COATING/LINING SYSTEM.
8. ADJUST FRAME AND COVER HEIGHT.
9. RESET FRAME AND COVER.

10. REMOVE ROOTS.
11. PROVIDE INFLOW INSERT/DISH/PAN.
12. REMOVE DEBRIS.
13. PERFORM STRUCTURAL REPAIR.
14. REPLACE FRAME AND COVER.
15. SEAL FRAME TO CORBEL/CONE CONNECTION WITH AN APPROVED POLYUREA COATING/LINING SYSTEM

It is implicit that many of the repair activities listed above will not be measured and paid for separately as they will be included in the cost of rehabilitating the manhole substrate. These activities include stopping active infiltration, patching voids, removal of loose coating materials, resurfacing of the corbel & wall, removing roots, and removing miscellaneous debris. Repair activities which will have a separate measurement and payment item include: Rebuilding/Repairing Bench & Channel/Trough; Interior Manhole Coating; Adjusting/Resetting Frame & Cover, Replacing Frame & Cover and Sealing Frame to Corbel Connection.

405-2. MEASUREMENT & PAYMENT

405-2.1. MANHOLE LINERS/COATING

Payment for manhole rehabilitation shall be per vertical linear foot of liner/coating which is installed/applied. Lining systems will generally be measured from the manhole bench to the top of existing, or new, corbel/cone. Cementitious, Epoxy and Polyurethane coating systems will be measured from the lowest pipe invert to the bottom of the manhole frame. No separate payment will be made for the following items: Flow Maintenance; Maintenance of Traffic; Debris Disposal; Miscellaneous Excavation, including necessary pavement removal and replacement; Infiltration control in manhole and at all pipe connections; Grout, Brick and mortar placement to fill voids and level surfaces; Brick replacement; Root removal, Installation of pipe extensions and connectors as necessary; Removal and replacement of manhole steps, Replacement of unpaved roadway and grass or shrubbery; Replacement of roadway base (including backfill and compaction) and asphalt surface; and Appurtenant work as required to complete the identified rehabilitation. The cost of such work shall be included in the pay item, per vertical linear foot of liner/coating.

405-2.2. REPLACE FRAME & COVER

Payment for manhole frame and cover replacement will include removal of existing frame and cover and replacement with a new frame and cover which meets the criteria established by *Section 401-4* of the city's specifications. The Contractor will also install and/or replace manhole pans and dishes if it is damaged or missing. Refer to *Section 401-2.2* from these *Section IV Technical Specifications*. Where manholes fall in paved areas, refer to *Standard Detail Index 104, "Street and Driveway Replacement for Concrete and Asphaltic Concrete Surfaces"*. Payment will be made for each manhole frame and cover replaced. No separate payment will be made for maintenance of traffic, necessary pavement removal and replacement, or replacement of grass or shrubbery.

405-2.3. REBUILD BENCH & CHANNEL/TROUGH

Payment for rebuilding bench and channel/trough will include removal of existing bench and channel (if applicable) and constructing a new bench and channel using the criteria established by *Section 401-1* of the city's specifications. Payment will be made for each bench and channel repaired/installed. No separate payment will be made for the removal of the existing bench and channel, by-pass pumping, and preparation of the manhole invert.

405-2.4. RESET/ADJUST MANHOLE FRAME & COVER

Payment for adjusting, or resetting, manhole frame will include removal of existing frame, removal of existing mortar, preparing top of corbel surface, installation of necessary riser material as described in *Section 401-2.1*, and placement of existing frame. No separate payment will be made for necessary maintenance of traffic, pavement removal and replacement, or replacement of grass or shrubbery. All work will be performed in accordance with *Section 401-4* of the city's specifications. Where manholes fall in paved areas, refer to *Standard Detail Index 104*, "Street and Driveway Replacement for Concrete and Asphaltic Concrete Surfaces". Payment will be made for each manhole frame and cover adjusted. No separate payment will be made for maintenance of traffic, necessary pavement removal and replacement, or replacement of grass or shrubbery.

405-2.5. SEAL MANHOLE FRAME TO CORBEL CONNECTION WITH POLYUREA MATERIAL

Payment for providing a water tight connection between the manhole frame and the manhole corbel /cone will include placement of non-shrink grout in any area between the frame and corbel which is void of mortar, preparing the frame and corbel/cone to accept the polyurea material and testing the thickness of the application. No separate payment will be made for necessary maintenance of traffic. All work will be performed in accordance with *Section 405-7* of the city's specifications.

405-3. CEMENTITIOUS COATING SYSTEM

This specification shall govern all work to spray/apply a monolithic fiber reinforced cementitious liner to the wall, channel, invert and bench surfaces of brick, concrete, or any other construction material; Strong Seal MS 2C product or approved equal.

Described are procedures for manhole cleaning preparation, application of material and testing. The applicator must be approved, trained and certified as having successfully completed factory training. The applicator/contractor shall furnish all labor, equipment and materials for applying the Strong Seal MS 2C product directly to the contour of the manhole to form a structural cementitious liner of a minimum one half inch (1/2") thickness using a machine specially designed for the application. As it is the intention of the city to rehabilitate the entire structure; corbel, walls, bench and channel/trough the contractor will be required to provide by-pass pumping as the necessary cure time exceeds four (4) hours. In no case will flow through plugs be allowed. All aspects of the installation shall be in accordance with the manufacturer's recommendations and with the following specifications:

1. The elimination of active infiltration prior to making the application.
2. The removal of any loose and unsound material.
3. The spray application of a pre-blended cementitious mix to form a monolithic liner in a two (2) coat application.

405-3.1. SUBMITTALS

Submittals shall be made in accordance with the following:

1. Technical data sheet on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.
2. Safety Data Sheets (SDS) for each product used.
3. Project specific guidelines and recommendations.
4. Applicator Qualifications:
 - a. Manufacturer certification that the Applicator has been trained in the handling, mixing and application of the products to be used.

- b. Certification that the equipment to be used for applying the products has been approved by the protective coating manufacturer and Applicator personnel have been trained and certified for proper use of the equipment.
- c. Written document providing three (3) years of experience and five (5) recent references of Applicator indicating successful application of the materials provided
- d. Installed a minimum of 50,000 square feet of plural component spray applied coating the same or similar to that specified within the last two (2) years.
- e. Proof of any necessary federal, state, or local permits or licenses necessary for the project.

405-3.2. MATERIALS

405-3.2.1. PATCHING MIX

A Strong A Seal or approved equal shall be used as a patching mix according to the manufacturer's recommendations and shall have the following minimum requirements:

1.	Compressive Strength (ASTM C109)	15 min., 200 psi; 6 hrs., 1,400 psi
2.	Shrinkage (ASTM C596)	28 days, 150 psi
3.	Bond (ASTM C1072)	28 days, 150 psi
4.	Cement Sulfate resistant	
5.	Density, when applied	105 +/- 5 pcf

405-3.2.2. INFILTRATION CONTROL

A Strong A Plug or approved equal shall be used to stop minor water infiltration according to the manufacturer's recommendations and shall have the following minimum requirements:

1.	Compressive strength (ASTM C109)	600 psi, 1 hr.; 1000 psi 24 hrs.
2.	Bond (ASTM C1072)	30 psi, 1 hr.; 80 psi, 24 hrs.

405-3.2.3. GROUTING MIX

Strong-Seal Grout or approved equal shall be used for stopping very active infiltration and filling voids according to the manufacturer's recommendations. The grout shall be volume stable and have a minimum twenty-eight (28) day compressive strength of 250 psi and a one (1) day strength of 50 psi.

405-3.2.4. COATING MIX

Strong Seal MS 2C or approved equal shall be used to form the monolithic liner covering all interior manhole surfaces and shall have the following minimum requirements at twenty-eight (28) days: The physical requirements must be verified by an independent, certified, third party testing laboratory within the last five years. The proposed third-party laboratory must be submitted with the bid package; any bid package not including the verifiable, independent third-party testing shall be ruled non-responsive and will be rejected.

1.	Compressive strength (ASTM C109)	3,000 psi
2.	Tensile strength (ASTM C496)	300 psi
3.	Flexural strength (ASTM C78)	600 psi
4.	Shrinkage (ASTM C596)	0% at 90% R.H.
5.	Bond (ASTM C1072)	130 psi
6.	Density, when applied	105 + pcf
7.	Chemical Resistance (ASTM D543/G20) immersion service for:	
	a. Municipal sanitary sewer environment	
	b. Sulfuric Acid, 30%	
	c. Sodium Hydroxide, 10%	
	d. Sodium Hypochlorite, 3%	

Fiberglass rods which are contained in the product shall be alkaline resistant and shall be one-half inch (1/2") to five-eighths inch (5/8") long with a diameter of 635 to 640 microns. Products shall, in the unmixed state, have a lead content not greater than two percent (2%) by weight. Strong Seal MS 2C shall be made with Calcium Aluminate Cement and shall be used according to the manufacturer's recommendations in applications where there is evidence of severe sulfide conditions.

Product must be factory blended requiring only the addition of water at job site. Bag weight shall be 50 to 51 pounds and contents must have a dry bulk density of 50 to 56 pounds per cubic foot. Cement content must be 65% to 75% of total weight of bag. One bag of product when mixed with correct amount of water must have a wet density of 95 to 108 pounds per cubic foot and must yield a minimum of 0.67 cubic foot of volume. Product shall not include any basic ingredient that exceeds maximum allowable EPA limit for any heavy metal.

Manufacturer must provide SDS sheets for product(s) to be used in reconstruction process. A two (2) coat application of liner material will be required (no exceptions) with the first coat rough troweled to force materials into cracks and crevices to set the bond. The second coat to be spray applied to assure a minimum of one-half inch (1/2") thickness after troweling or brush finishing to a relatively smooth finish.

405-3.2.5. WATER

Water shall be clean and potable not to exceed 80°F (Fahrenheit).

405-3.2.6. OTHER MATERIALS

No other material shall be used with the mixes previously described without prior approval or recommendation from the manufacturer.

405-3.3. APPLICATION EQUIPMENT

A specially designed machine consisting of an optimized progressive cavity pump capable of producing a minimum of 250 psi pumping pressure, contra blend mixer with twin ribbon paddles with discharge, and an air system for spray application of product. Equipment must be complete with water storage and metering system. Mixer and pump are to be hydraulically powered. Equipment is to be mounted to heavy duty construction tandem axle road worthy trailer complete with electric brakes and running lights. Internal combustion engine must be included to power the hydraulic system and air compressor.

405-3.4. INSTALLATION AND EXECUTION

405-3.4.1. PREPARATION

1. All foreign material shall be removed from the manhole wall and bench using a high-pressure water spray (minimum 1,200 psi). Loose and protruding brick, mortar and concrete shall be removed using a mason's hammer and chisel and/or scraper. Fill any large voids with brick and quick setting patching mix.
2. Active leaks shall be stopped using quick setting specially formulated mixes according to the manufacturer's recommendations. When severe infiltration is present, drilling may be required in order to pressure grout using a cementitious grout. Manufacturer's recommendations shall be followed when pressure grouting is required.
3. Any bench, invert/channel/trough or service line repairs shall be made at this time using the quick setting mix and following the manufacturer's recommendations.
4. Any active flows shall be dammed, plugged, or diverted as required to ensure all liquids are maintained below or away from the surfaces to be coated until final applications are cured as recommended by the manufacturer.

5. Prior to commencing surface preparation, Contractor shall inspect all surfaces specified to receive the coating and notify city, in writing, of any noticeable disparity in the site, structure or surfaces which may interfere with the work, use of materials or procedures as specified herein.

405-3.4.2. MIXING

For each bag of product, use the amount of water specified by the manufacturer and mix using the Spray Mate Model 35C or 35D equipment for thirty (30) seconds to one (1) minute after all materials have been placed in the mixing hopper. Place the mix into the holding hopper and prepare another batch with timing such that the nozzleman can spray in a continuous manner without interruption until each application is complete.

405-3.4.3. SPRAYING

The surface, prior to spraying, shall be damp without noticeable free water droplets or running water. Materials shall be sprayed, applied to a minimum uniform thickness to ensure that all cracks, crevices and voids are filled, and a somewhat smooth surface remains after light troweling. The light troweling is performed to compact the material into voids and to set the bond. Not before the first application has begun to take an initial set (disappearance of surface sheen which could be fifteen (15) minutes to one (1) hour depending upon ambient conditions) is the second application made to assure a minimum total finished thickness of one-half inch (1/2"). The surface is then troweled to a smooth finish being careful not to over trowel so as to bring additional water to the surface and weaken it. A brush finish may be applied to the finished coat to remove trowel marks. Manufacturer's recommendation shall be followed whenever more than twenty-four (24) hours have elapsed between applications. The bench will be sprayed such that a gradual slope is produced from the walls to the invert with the thickness at the edge of the invert being no less than one-half inch (1/2"). The invert/channel/trough area shall also be sprayed in a manner that provides a gradual slope through the structure while achieving one-quarter inch (1/4") thickness coverage. The wall/bench and bench/invert/channel/trough intersections shall be rounded to a uniform radius, the full circumference of the intersection. The final application shall have a minimum of four (4) hours cure time before being subjected to active flow. The corbel/cone to manhole frame joint shall be sealed according to *Section 405-7*.

405-3.4.4. PREPARATION OF SAMPLES

At some point during the application, at least four (4) two inch (2") cubes will be prepared for each manhole, or from every fifty (50) bags of product used, identified and submitted, in accordance with the city's or Manufacturer's directions, for compression strength testing as described in ASTM C109.

405-3.4.5. CURING

Ambient manhole conditions are adequate for curing so long as the manhole is covered. It is imperative that the manhole be covered as soon as possible after the application has been completed.

405-3.5. TESTING AND ACCEPTANCE

Manhole will be vacuum tested from the top of manhole frame to the manhole base. All pipes entering the manhole shall be plugged, taking care to securely place the plug from being drawn into the manhole. The test head shall be placed, and the seal inflated in accordance with the manufacturers' recommendations. A vacuum pump of ten inches (10") of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to nine inches (9"). The manhole shall pass if the time is greater than sixty (60) seconds for forty-eight inch (48") diameter, seventy five (75) seconds for sixty inch diameter (60"), and ninety (90) seconds for seventy-two inch (72") diameter manholes. If the manhole fails the initial test, necessary repairs shall be made. Retesting shall proceed until a satisfactory test is obtained. Tests shall be performed by the Contractor under the direction of the city.

405-4. RAVEN 405 EPOXY COATING SYSTEM

This specification shall govern all work to spray/apply a monolithic epoxy material to the wall, channel, invert and bench surfaces of brick, concrete, or any other construction material; Raven 405 product or approved equal.

Described are procedures for manhole cleaning preparation, application of material and testing. The applicator must be approved, trained, and certified as having successfully completed factory training. The applicator/contractor shall furnish all labor, equipment, and materials for applying the Raven 405 product directly to the contour of the manhole to form a structural liner of a minimum 125 mil thickness using a machine specially designed for the application. As it is the intention of the city to rehabilitate the entire structure; corbel, walls, bench, and channel/trough the contractor will be required to provide by-pass pumping as necessary if the cure time exceeds one (1) hour. In no case will flow through plugs be allowed. All aspects of the installation shall be in accordance with the manufacturer's recommendations and with the following specifications:

1. The elimination of active infiltration prior to making the application.
2. The removal of any loose and unsound material.
3. Preparing the manhole to provide a clean, dry, sound and monolithically smooth surface
4. The spray application of a Solvent-free epoxy coating to be applied to specified thickness

405-4.1. SUBMITTALS

Submittals shall be made in accordance with the following:

1. Technical data sheet on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.
2. Safety Data Sheets (SDS) for each product used.
3. Project specific guidelines and recommendations.
4. Applicator Qualifications:
 - a. Manufacturer certification that the Applicator has been trained in the handling, mixing and application of the products to be used.
 - b. Certification that the equipment to be used for applying the products has been approved by the protective coating manufacturer and Applicator personnel have been trained and certified for proper use of the equipment.
 - c. Written document providing three (3) years of experience and five (5) recent references of Applicator indicating successful application of a 100% solids high-build solvent-free coating by spray application.
 - d. Applicator must provide written documentation of having installed a minimum of 50,000 square feet of plural component spray applied epoxy coating the same or similar to that specified within the last two (2) years.
 - e. Proof of any necessary federal, state, or local permits or licenses necessary for the project.

405-4.2. MATERIALS

405-4.2.1. PATCHING MIX

Strong Seal, or approved equal, shall be used as a patching mix according to the manufacturer's recommendations and shall have the following minimum requirements:

1.	Compressive Strength (ASTM C-109)	15 min., 200 psi; 6 hrs., 1,400 psi
2.	Shrinkage (ASTM C-596)	28 days, 150 psi
3.	Bond (ASTM C-952)	28 days, 150 psi
4.	Cement Sulfate resistance	

5.	Density, when applied	105 +/- 5 pcf
----	-----------------------	---------------

405-4.2.2. INFILTRATION CONTROL

Strong Plug, or approved equal, shall be used to stop minor water infiltration according to the manufacturer's recommendations and shall have the following minimum requirements:

1.	Compressive strength (ASTM C109)	600 psi, 1 hr.; 1000 psi 24 hrs.
2.	Bond (ASTM C1072)	30 psi, 1 hr.; 80 psi, 24 hrs.

405-4.2.3. GROUTING MIX

Strong-Seal Grout, or approved equal, shall be used for stopping very active infiltration and filling voids according to the manufacturer's recommendations. The grout shall be volume stable and have a minimum twenty-eight (28) day compressive strength of 250 psi and one (1) day strength of 50 psi.

405-4.2.4. COATING MATERIAL

Coating product shall be applied to all interior surfaces to protect the host substrate and repair materials from all forms of chemical or bacteriological attack typically found in municipal sanitary sewer systems and to impart a degree of structural enhancement.

Coating product physical properties shall be substantiated through submittal of accredited third-party testing results and shall be representative of the actual field applied product and cure mechanism(s) to be employed in the field. The physical requirements must be verified by an independent third-party testing shall be ruled non-responsive and will be rejected.

100% Solids, Solvent-Free, Ultra-High Build Epoxy Coating to be spray applied to all interior surfaces of exposed concrete above the spring line or as otherwise detailed:

1. Manufacturer: Raven Lining Systems, Broken Arrow, Oklahoma 800-324-2810 or 918-615-0140 fax.
2. Product: Raven 405, or approved equal – 100% solids, solvent-free ultra-high-build epoxy system exhibiting the following characteristics:
 - a. Product Type: amine cured epoxy
 - b. VOC Content (ASTM D2584): 0%
 - c. Compressive Strength, (ASTM D695): 18,000 psi
 - d. Tensile Strength, (ASTM D638): 7,600 psi
 - e. Flexural Modulus, (ASTM D790): 700,000 psi
 - f. Adhesion to Concrete, (ASTM D4541/7234): >200 psi with substrate (concrete) failure
 - g. Chemical Resistance (ASTM D543/G20) immersion service for:
 - Municipal sanitary sewer environment
 - Sulfuric Acid, 30%
 - Sodium Hydroxide, 10%
 - Sodium Hypochlorite, 3%
 - h. Successful Pass: Sanitation District of L.A. County Coating Evaluation Study and SSPWC 210.2.3.3 (Greenbook “Pickle Jar” Chemical Resistance test) 100% Solids, Solvent-Free, Ultra-High Build Epoxy Coating to be manually or spray applied to interior surfaces of exposed concrete above or below the typical flow line; specifically designed for accelerated cure and suitable for release of flow in less than 45 minutes at normal service temperatures or as otherwise detailed.

405-4.2.5. OTHER MATERIALS

No other material shall be used with the mixes previously described without prior city approval.

405-4.3. INSTALLATION AND EXECUTION

405-4.3.1. PREPARATION

1. All foreign material shall be removed from the manhole wall and bench using a high-pressure water spray (minimum 5,000 psi). Loose and protruding brick, mortar and concrete shall be removed using a mason's hammer and chisel and/or scraper. Fill any large voids with brick and quick setting patching mix.
2. Active leaks shall be stopped using quick setting specially formulated mixes according to the manufacturer's recommendations. When severe infiltration is present, drilling may be required in order to pressure grout using a cementitious grout. Manufacturer's recommendations shall be followed when pressure grouting is required.
3. Any bench, invert/channel/trough or service line repairs shall be made at this time using the quick setting mix and following the manufacturer's recommendations.
4. Any active flows shall be dammed, plugged, or diverted as required to ensure all liquids are maintained below or away from the surfaces to be coated until final applications are cured as recommended by the manufacturer.
5. The area between the corbel and the manhole frame and any other area that might exhibit movement or cracking due to expansion and contraction shall be grouted with a flexible grout or gel. A termination groove "key" cut into the substrate between the bottom of the manhole frame and concrete is recommended for placement of the flexible grout or gel. The "key" shall be a minimum ¼" w x ¼" d, cut at a minimum 45° angle (60° maximum).
6. Prior to commencing surface preparation, Contractor shall inspect all surfaces specified to receive the coating and notify city, in writing, of any noticeable disparity in the site, structure or surfaces which may interfere with the work, use of materials or procedures as specified herein.

405-4.3.2. APPLICATION

Application procedures shall conform to the recommendations of the coating product(s) manufacturer, including environmental controls, product handling, mixing, application equipment, and methods. Spray equipment shall be specifically designed to accurately ratio and apply the coating product(s) and s Prepared surfaces shall be coated via spray application of the coating product(s) described herein unless otherwise recommended by the coating product manufacturer.

In all cases the coating product shall be applied to a minimum dry film thickness of 125 mils to surface profiles. Subsequent top coating or additional coats of the coating product(s) shall occur within the products recoat window. Additional surface preparation procedures will be required if this recoat window is exceeded.

Coating product(s) shall interface with adjoining construction materials/components throughout the manhole structure to effectively seal and protect substrates from attack by corrosive elements and to ensure the effective elimination of infiltration into the sewer system. Termination points of the coating product(s) shall be made at the manhole frame and corbel joint (or other man way as is present), and a minimum of 1" interfacing within each pipe penetrating the structure. The corbel/cone to manhole frame joint shall be sealed according to *Section 405-7*. The entire bench and invert/channel/trough will be thoroughly coated noting that the invert/channel/trough area will be sprayed in a manner that provides a gradual slope through the structure while achieving 125 mils thickness coverage.

405-4.4. TESTING & ACCEPTANCE

Coating system thickness shall be inspected to ensure compliance with the specifications herein.

1. During application a wet film thickness gauge, meeting ASTM D4414 (latest edition) - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be

used. Measurements shall be taken, documented, and attested to by Contractor for submission to the city.

2. After the coating product(s) have cured in accordance with manufacturer recommendations, coating system thickness shall be measured according to SSPC-PA 9 - Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages.

High voltage holiday detection for coating systems installed in corrosive environments, when it can be safely and effectively employed, shall be performed to ensure monolithic protection of the substrate. After the coating product(s) have cured in accordance with manufacturer recommendations, all surfaces shall be inspected for holidays in accordance with NACE RPO 188-99 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates or ASTM D4787 Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates. All detected holidays shall be marked and repaired according to the coating product(s) manufacturer's recommendations.

1. Test voltage shall be a minimum of 100 volts per mil of coating system thickness.
2. Detection of a known or induced holiday in the coating product shall be confirmed to ensure proper operation of the test unit.
3. All areas repaired shall be retested following cure of the repair material(s).
4. In instances where high voltage holiday detection is not feasible a close visual inspection shall be conducted, and all possible holidays shall be marked and repaired as described above.
5. Documentation of areas tested, equipment employed, results, and repairs made shall be submitted to the city by the Contractor.

Adhesion of the coating system to the substrate shall be confirmed in a minimum of 10% of the manholes coated, or for large structures once every 1000 square feet of coated area. After the coating product(s) have cured in accordance with manufacturer recommendations, testing shall be conducted in accordance with ASTM D7234 Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers. city's Project Manager shall select the manholes/areas to be tested.

1. For each test manhole a minimum of three 20 mm dollies shall be affixed to the coated surface; one at the cone/corbel area, one at the midsection and one near the bottom of the structure.
2. For larger structures a minimum of three 20 mm dollies shall be affixed to the coated surface at random locations within each 1000 square foot area or as otherwise agreed upon.
3. The adhesive used to attach the dollies to the coating shall be rapid setting with tensile strengths in excess of at least twice the anticipated failure point (generally 1000 psi) and permitted to cure in accordance with manufacturer recommendations. The coating and dollies shall be adequately cleaned and prepared to receive the adhesive. Failure of the dolly adhesive shall be deemed a non-test and require retesting.
4. Prior to performing the pull test, the coating shall be scored to the substrate, or within 10 mils of the substrate surface, by mechanical means without disturbing the dolly or coating system bond within the test area.
5. Two of the three adhesion pulls in each test area shall exceed 200 psi and shall include substrate adhered to the back of the dolly or no visual signs of the coating product in the test hole. Pulls tests with results between 150 and 200 psi may be acceptable if more than 50 percent of the substrate in the test area is adhered to the dolly.
6. Should a structure, or area, fail to achieve two successful pulls as described above, additional testing shall be performed at the discretion of the Owner or Project Engineer. Any areas detected to have inadequate bond strength shall be evaluated by the city. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Contractor.
7. All adhesion testing shall be performed by qualified personnel using calibrated equipment as specified by the applicable ASTM standard(s).

8. All adhesion testing shall be documented and submitted in a consistent format detailing location, test values, description of the failure point/mode, scoring method employed, adhesive used, cure time of coating and adhesive and other data as deemed necessary by the city.
9. All adhesion test locations shall be repaired by the Contractor at no cost to the city.
10. Visual inspection shall be made by the Project Engineer and/or Inspector. Any deficiencies in the finished coating affecting the performance of the coating system or the operational functionality of the structure shall be marked and repaired according to the recommendations of the coating product(s) manufacturer.

405-5. SPRAYWALL POLYURETHANE COATING SYSTEM

This specification shall govern all work to spray/apply a monolithic polyurethane material to the wall, channel, invert and bench surfaces of brick, concrete, or any other construction material; SprayWall product or approved equal.

Described are procedures for manhole cleaning preparation, application of material and testing. The applicator must be approved, trained and certified as having successfully completed factory training. The applicator/contractor shall furnish all labor, equipment and materials for applying the SprayWall product directly to the contour of the manhole to form a structural liner of a minimum 125 thickness using a machine specially designed for the application. As it is the intention of the city to rehabilitate the entire structure; corbel, walls, bench and channel/trough the contractor will be required to provide by-pass pumping as the necessary if the cure time exceeds one (1) hour. In no case will flow through plugs be allowed. All aspects of the installation shall be in accordance with the manufacturer's recommendations and with the following specifications:

1. The elimination of active infiltration prior to making the application.
2. The removal of any loose and unsound material.
3. Preparing the manhole to provide a clean, dry, sound and monolithically smooth surface
4. The spray application of a Solvent-free polyurethane coating to be applied to specified thickness.

405-5.1. SUBMITTALS

The following items shall be submitted:

1. Technical data sheet on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.
2. Safety Data Sheets (SDS) for each product used.
3. Project specific guidelines and recommendations.
4. Applicator Qualifications:
 - a. Manufacturer certification that the Applicator has been trained in the handling, mixing and application of the products to be used.
 - b. Certification that the equipment to be used for applying the products has been approved by the protective coating manufacturer and Applicator personnel have been trained and certified for proper use of the equipment.
 - c. Written document providing three (3) years of experience and five (5) recent references of Applicator indicating successful application of a 100% solids high-build solvent-free coating by spray application.
 - d. Written document stating that the contractor has installed a minimum of 50,000 square feet of plural component spray applied polyurethane coating the same or similar to that specified within the last two (2) years.
 - e. Proof of any necessary federal, state or local permits or licenses necessary for the project.

405-5.2. MATERIALS

405-5.2.1. PATCHING MIX

Strong Seal, or approved equal, shall be used as a patching mix according to the manufacturer's recommendations and shall have the following minimum requirements:

1.	Compressive Strength (ASTM C109)	15 min., 200 psi; 6 hrs., 1,400 psi
2.	Shrinkage (ASTM C596)	28 days, 150 psi
3.	Bond (ASTM C952)	28 days, 150 psi
4.	Cement Sulfate resistant	
5.	Density, when applied	105 +/- 5 pcf

405-5.2.2. INFILTRATION CONTROL

Strong Plug, or approved equal, shall be used to stop minor water infiltration according to the manufacturer's recommendations and shall have the following minimum requirements:

1.	Compressive strength (ASTM C109)	600 psi, 1 hr.; 1000 psi 24 hrs.
2.	Bond (ASTM C952)	30 psi, 1 hr.; 80 psi, 24 hrs.

405-5.2.3. GROUTING MIX

Strong-Seal Grout, or approved equal, shall be used for stopping very active infiltration and filling voids according to the manufacturer's recommendations. The grout shall be volume stable and have a minimum twenty-eight (28) day compressive strength of 250 psi and a one (1) day strength of 50 psi.

405-5.2.4. COATING MATERIAL

The resin-based material shall be used to form the sprayed structurally enhanced monolithic liner covering all interior surfaces of the structure, including benches and channels/troughs of manholes. The finished liner shall be SprayWall® as manufactured by Sprayroq, Inc. or approved equal and conform to the minimum physical requirements listed below. A minimum of 125 mil. coating thickness is required.

The physical requirements must be verified by an independent, certified, third party testing laboratory within the last five years and must be submitted with the bid package. Any bid package not including the verifiable, independent third-party testing shall be ruled non-responsive and will be rejected.

1.	VOC Content (ASTM D2584)	0%
2.	Compressive Strength, (ASTM D695)	18,000 psi
3.	Tensile Strength, (ASTM D638)	> 7,450 psi
4.	Flexural Modulus, (ASTM D790)	735,000 psi
5.	Adhesion to Concrete, (ASTM D4541/7234)	>200 psi with substrate (concrete) failure
6.	Chemical Resistance (ASTM D543/G20) immersion service for:	<ul style="list-style-type: none"> • Municipal sanitary sewer environment • Sulfuric Acid, 30% • Sodium Hydroxide, 10% • Sodium Hypochlorite, 3%
7.	Successful Pass:	Sanitation District of L.A. County Coating Evaluation Study and SSPWC 210.2.3.3 (Greenbook "Pickle Jar" Chemical Resistance test)

The initial flexural modulus of elasticity (short term) of the submitted resin material will be utilized with the long-term deformation percentage as determined by ASTM D2990 (see below) in the design equation outlined in ASTM 1216-09, Appendix X1. The value of the long-term flexural modulus of the proposed product will be certified by an independent, certified, third party testing lab, independent of the

Manufacturer and submitted with the bid package. [The definition of long-term value will be identified as initial flexural VER 01 w/Flat Wall 2015 Page 7 of 12 modulus of elasticity less the reduction in value caused by Creep over a fifty (50) year minimum period and verified by third party DMA testing (ASTM D2990).] All design submittals will include this certified third-party DMA testing (ASTM D2990) value in their respective design calculations for each structure being rehabilitated.

Coating product physical properties shall be substantiated through submittal of accredited third-party testing results and shall be representative of the actual field applied product and cure mechanism(s) to be employed in the field.

Polyurethane coating to be manually or spray applied to interior surfaces of exposed concrete above or below the typical flow line; specifically designed for accelerated cure and suitable for release of flow in less than 45 minutes at normal service temperatures or as otherwise detailed.

405-5.2.5. OTHER MATERIALS

No other material shall be used with the mixes previously described without prior approval or recommendation from the manufacturer.

405-5.3. INSTALLATION AND EXECUTION

405-5.3.1. PREPARATION

1. All foreign material shall be removed from the manhole wall and bench using a high-pressure water spray (minimum 5,000 psi). Loose and protruding brick, mortar and concrete shall be removed using a mason's hammer and chisel and/or scraper. Fill any large voids with brick and quick setting patching mix.
2. Active leaks shall be stopped using quick setting specially formulated mixes according to the manufacturer's recommendations. When severe infiltration is present, drilling may be required in order to pressure grout using a cementitious grout. Manufacturer's recommendations shall be followed when pressure grouting is required.
3. Any bench, invert/channel/trough or service line repairs shall be made at this time using the quick setting mix and following the manufacturer's recommendations.
4. Any active flows shall be dammed, plugged, or diverted as required to ensure all liquids are maintained below or away from the surfaces to be coated until final applications are cured as recommended by the manufacturer.
5. The area between the corbel and the manhole frame and any other area that might exhibit movement or cracking due to expansion and contraction, shall be grouted with a flexible grout or gel (Sikadur 42 Grout Pak LE, Pro-Stik Butyl Sealant, or equal). A termination groove "key" cut into the substrate between the bottom of the manhole frame and concrete is recommended for placement of the flexible grout or gel. The "key" shall be a minimum ¼" w x ¼" d, cut at a minimum 45° angle (60° maximum).
6. Prior to commencing surface preparation, Contractor shall inspect all surfaces specified to receive the coating and notify city, in writing, of any noticeable disparity in the site, structure or surfaces which may interfere with the work, use of materials or procedures as specified herein.

405-5.3.2. APPLICATION

Application procedures shall conform to the recommendations of the protective coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment. The spray equipment shall be specifically designed to accurately ratio and apply the specified protective coating materials and shall be regularly maintained and in proper working order.

The protective coating material must be spray applied by a Certified Applicator of the protective coating manufacturer. Specified surfaces shall be coated by spray application of a solvent-free, 100% solids, rigid polyurethane structural lining as further described herein. Airless spray application equipment approved by the coating manufacturer shall be used to apply each coat of the protective coating. The air source is to be filtered to completely remove all oil and water.

If necessary, subsequent top coating or additional coats of the protective coating should occur as soon as the basecoat becomes tack free, no later than the recoat window for the specified products. Additional surface preparation procedures will be required if this recoat window is exceeded.

The roughness of the substrate will dictate the thickness needed to create the monolithic liner and eliminate any opportunity for voids in the coating. The minimum value for coating thickness shall be a minimum 125 mils.

Coating product(s) shall interface with adjoining construction materials/components throughout the manhole structure to effectively seal and protect substrates from attack by corrosive elements and to ensure the effective elimination of infiltration into the sewer system.

Termination points of the coating product(s) shall be made at the manhole frame and corbel joint (or other man way as is present), and a minimum of 1" interfacing within each pipe penetrating the structure. The entire bench and invert/channel/trough will be thoroughly coated noting that the invert/channel/trough area will be sprayed in a manner that provides a gradual slope through the structure while achieving 125 mils. thickness coverage.

405-5.4. TESTING & ACCEPTANCE

Coating system thickness shall be inspected to ensure compliance with the specifications herein.

1. During application a wet film thickness gauge, meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used. Measurements shall be taken, documented, and attested to by Contractor for submission to the city.
2. After the coating product(s) have cured in accordance with manufacturer recommendations, coating system thickness may be measured according to SSPC-PA 9 - Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages.

High voltage holiday detection for coating systems installed in corrosive environments, when it can be safely and effectively employed, shall be performed to ensure monolithic protection of the substrate. After the coating product(s) have cured in accordance with manufacturer recommendations, all surfaces shall be inspected for holidays in accordance with NACE RPO 188-99 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates or ASTM D4787 Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates. All detected holidays shall be marked and repaired according to the coating product(s) manufacturer's recommendations.

1. Test voltage shall be a minimum of 100 volts per mil of coating system thickness.
2. Detection of a known or induced holiday in the coating product shall be confirmed to ensure proper operation of the test unit.
3. All areas repaired shall be retested following cure of the repair material(s).
4. In instances where high voltage holiday detection is not feasible a close visual inspection shall be conducted, and all possible holidays shall be marked and repaired as described above.
5. Documentation of areas tested, equipment employed, results, and repairs made shall be submitted to the city by the Contractor.

Adhesion of the coating system to the substrate shall be confirmed in a minimum of 10% of the manholes coated, or for large structures once every 1000 square feet of coated area. After the coating product(s) have cured in accordance with manufacturer recommendations, testing shall be conducted in accordance with

ASTM D7234 Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers. City's Project Manager shall select the manholes/areas to be tested.

1. For each test manhole a minimum of three 20 mm dollies shall be affixed to the coated surface; one at the cone/corbel area, one at the midsection and one near the bottom of the structure.
2. For larger structures a minimum of three 20 mm dollies shall be affixed to the coated surface at random locations within each 1000 square foot area or as otherwise agreed upon.
3. The adhesive used to attach the dollies to the coating shall be rapid setting with tensile strengths in excess of at least twice the anticipated failure point (generally 1000 psi) and permitted to cure in accordance with manufacturer recommendations. The coating and dollies shall be adequately cleaned and prepared to receive the adhesive. Failure of the dolly adhesive shall be deemed a non-test and require retesting.
4. Prior to performing the pull test, the coating shall be scored to the substrate, or within 10 mils of the substrate surface, by mechanical means without disturbing the dolly or coating system bond within the test area.
5. Two of the three adhesion pulls in each test area shall exceed 200 psi and shall include substrate adhered to the back of the dolly or no visual signs of the coating product in the test hole. Pulls tests with results between 150 and 200 psi may be acceptable if more than 50 percent of the substrate in the test area is adhered to the dolly.
6. Should a structure, or area, fail to achieve two successful pulls as described above, additional testing shall be performed at the discretion of the Owner or Project Engineer. Any areas detected to have inadequate bond strength shall be evaluated by the city. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Contractor.
7. All adhesion testing shall be performed by qualified personnel using calibrated equipment as specified by the applicable ASTM standard(s).
8. All adhesion testing shall be documented and submitted in a consistent format detailing location, test values, description of the failure point/mode, scoring method employed, adhesive used, cure time of coating and adhesive and other data as deemed necessary by the city.
9. All adhesion test locations shall be repaired by the Contractor at no cost to the city.
10. Visual inspection shall be made by the city's agent and/or Inspector. Any deficiencies in the finished coating affecting the performance of the coating system or the operational functionality of the structure shall be marked and repaired according to the recommendations of the coating product(s) manufacturer.

405-6. INTERNAL MANHOLE CORBEL SEALING SYSTEM

This specification shall govern all work to spray/apply a monolithic polyurea material to the frame and adjacent corbel surfaces of brick, concrete or any other construction material.

The work covered by this item includes but is not limited to furnishing all labor, equipment, materials and supervision, and performing all work necessary to seal the manhole as specified herein or equal to the manhole through the frame joint area and the area above the manhole corbel/cone.

Described are procedures for manhole/frame cleaning preparation, application of material and testing. The applicator must be approved, trained and certified as having successfully completed factory training. The applicator/contractor shall furnish all labor, equipment and materials for applying the product directly to the manhole and frame joint with a minimum of 6-inch overlap on each surface and a minimum thickness of 125 mils. All aspects of the installation shall be in accordance with the manufacturer's recommendations and with the following specifications:

1. The removal of any rust or loose and unsound material.

2. Preparing the manhole corbel/cone and frame to provide a clean, dry, sound and monolithically smooth surface
3. The spray application of a Solvent-free polyurea coating to be applied to specified thickness.

405-6.1. SUBMITTALS

The following items shall be submitted:

1. Technical data sheet, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.
2. Safety Data Sheet for the product (SDS).
3. Project specific guidelines and recommendations.
4. Applicator Qualifications:
 - a. Manufacturer certification that the Applicator has been trained in the handling, mixing and application of the products to be used.
 - b. Certification that the equipment to be used for applying the products has been approved by the protective coating manufacturer and Applicator personnel have been trained and certified for proper use of the equipment.
 - c. Written document providing three (3) years of experience and five (5) recent references of Applicator indicating successful application of a 100% solids high-build solvent-free coating by spray application.
 - d. Proof of any necessary federal, state, or local permits or licenses necessary for the project.

405-6.2. MATERIALS

405-6.2.1. PATCHING MIX

Strong Seal, or approved equal, shall be used as a patching mix according to the manufacturer's recommendations and shall have the following minimum requirements:

1.	Compressive Strength (ASTM C109)	15 min., 200 psi; 6 hrs.; 1,400 psi
2.	Shrinkage (ASTM C596)	28 days, 150 psi
3.	Bond (ASTM C952)	28 days, 150 psi
4.	Cement Sulfate resistant	
5.	Density, when applied	105 +/- 5 pcf

405-6.2.2. INFILTRATION CONTROL

Strong Plug, or approved equal, shall be used to stop minor water infiltration according to the manufacturer's recommendations and shall have the following minimum requirements:

1.	Compressive strength (ASTM C109)	600 psi, 1 hr.; 1000 psi 24 hrs.
2.	Bond (ASTM C952)	30 psi, 1 hr.; 80 psi, 24 hrs.

405-6.2.3. COATING MATERIAL

Manhole seal shall be designed to prevent leakage of water into the manhole through the frame joint area and the area above the manhole cone including all extensions to the corbel area. The seal shall remain flexible allowing for the repeated vertical or horizontal movements of the frame due to frost lift, ground movement or the thermal movement of pavements. The final coating shall be made no less than 125 mils. of corrosion resistant aromatic or approved equal. The product shall have a minimum elongation of 800%. Final liner shall have a minimum tensile strength of 3250 psi. The manhole sealing system shall conform to the physical requirements of ASTM D412.

The physical requirements must be verified by an independent, certified, third party testing laboratory within the last five years and must be submitted with the bid package. Any bid package not including the verifiable, independent third-party testing shall be ruled non-responsive and will be rejected.

405-6.3. INSTALLATION AND EXECUTION

405-6.3.1. PREPARATION

1. All foreign material shall be removed from the manhole wall and bench using a high-pressure water spray (minimum 5,000 psi). Loose and protruding brick, mortar and concrete shall be removed using a mason's hammer and chisel and/or scraper. Fill any large voids with brick and quick setting patching mix.
2. All patching materials shall be cured prior to the installation. Preparation of the frame surface shall include sandblasting (minimum of 70 CFM) and an acetone wet wipe to ensure a clean surface as required by manufacturer on uncoated substrate.
3. If coating is to be on top of SprayWall, or Raven 405, then termination points need to be cut which are ¼" x ¼" cut on 45° angle at top and bottom of application, then sanding of the SprayWall, or Raven 405, with 40 grit paper, cleaned and an application of Lords 7701 is required prior to application to ensure adhesion.
4. Prior to commencing surface preparation, Contractor shall inspect all surfaces specified to receive the coating and notify city, in writing, of any noticeable disparity in the site, structure or surfaces which may interfere with the work, use of materials or procedures as specified herein.

405-6.3.2. APPLICATION

Application procedures shall conform to the recommendations of the polyurea coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment.

The spray equipment shall be specifically designed to accurately ratio and apply the specified protective coating materials and shall be regularly maintained and in proper working order. The polyuria coating material must be spray applied by a Certified Applicator of the coating manufacturer.

Airless spray application equipment approved by the coating manufacturer shall be used to apply each coat of the protective coating. The air source is to be filtered to completely remove all oil and water.

If necessary, subsequent top coating or additional coats of the polyurea coating should occur as soon as the basecoat becomes tack free, no later than the recoat window for the specified products. Additional surface preparation procedures will be required if this recoat window is exceeded.

405-6.3.3. TESTING & ACCEPTANCE

Coating system thickness shall be inspected to ensure compliance with the specifications herein.

1. During application a wet film thickness gauge, meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used. Measurements shall be taken, documented, and attested to by Contractor for submission to the city.
2. After the coating product(s) have cured in accordance with manufacturer recommendations, coating system thickness may be measured according to SSPC-PA 9 - Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages.
3. Visual inspection shall be made by the city's agent and/or Inspector. Any deficiencies in the finished coating affecting the performance of the coating system or the operational functionality of the structure shall be marked and repaired according to the recommendations of the coating product(s) manufacturer. The contractor shall warrantee proper adhesion of the coating material to the frame and corbel/cone for a minimum of ten (10) years.

406. SMOKE AND DYE TESTING

406-1. GENERAL PROTOCOL

Conduct smoke testing of gravity sewers for defects and identify manholes which could not be located, and all new structures not shown on GIS. Smoke and Dye testing will be completed using the following Protocols:

Smoke testing will provide detailed information on wet weather inflow sources to the sanitary sewer. In order to identify collection system defects and illicit connections, non-toxic smoke will be forced into the sewer by high-capacity blower capable of achieving a minimum of 1,750 cfm of airflow. Any break in the sewer will allow the smoke to escape provided the smoke machine generates sufficient pressure. One line segment will be tested at one time with plugging. The maximum length of sewer to be smoke tested in a single setup shall be 400 linear feet per blower. Dual blower smoke testing shall be performed for pipe sections over 400 linear feet with a maximum of 800 linear feet. Smoke testing shall not be performed during or following weather conditions that may impair detecting escaping smoke (i.e. very windy, rainy, or high groundwater conditions, etc.) Smoke testing will not be performed on surcharged lines. In case of surcharged lines, the selected Contractor will contact the city and identify the issue. Once the surcharge has been eliminated, the city will contact the selected Contractor to re-smoke the test area. Smoke testing will document when smoke does not travel the entire length of piping, or when smoke is not detected at the roof stack of connecting buildings. In these cases, CCTV inspection (by others) will be required of both mainline and lateral piping. When a defect is identified as being a potential significant inflow source it will be recommended for dye testing. The smoke shall be non-toxic, odorless, and non-staining. A Safety Data Sheet shall be submitted and approved by city prior to the commencement of smoke testing.

Prior to testing, the selected Contractor shall submit a schedule outlining test dates and locations to the city, three weeks prior to commencing the smoke testing. The selected Contractor shall prepare Smoke Testing notices (English & Spanish) advising residents and local authorities of the smoke testing program. The notices shall be approved by the city prior to distribution. Extra copies of the notices will be provided to the city for distribution to other city agencies, including the Fire Department, Police Department, Emergency Services and others. The selected Contractor shall distribute smoke testing notices to residences in the project area including the local fire and police precincts, approximately 48-72 hours in advance of the smoke testing. For large facilities such as schools or hospitals, a log will be maintained that documents the property manager's notification of planned smoke testing activities. A local Contractor's telephone number will be provided for those individuals with questions or for anyone requiring special assistance. Field personnel will be uniformed and will conspicuously display identification badges. Private individuals requesting additional identification will be asked to contact the city and crews shall carry a letter from the city authorizing the holder of the letter to perform the work described. Each day the fire department and other affected agencies will be notified of the crew location since smoke may enter homes through defective plumbing.

406-2. REPORTING

Field results shall be documented in an Excel spreadsheet and on printed maps. The Excel spreadsheet shall include the following information:

- a. defect and photo number
- b. address and locations of defects
- c. type of defect found
- d. is defect public or private
- e. address of residences that did not smoke during testing and residents' houses that were smoked with defect description (if possible)

SECTION IV – Technical Specifications

- f. address of residences that did not have a cleanout plug(s) or lids and or in low-lying areas
- g. manholes ID on those with no manhole inserts, with debris, or in low-lying areas
- h. any defective sewer mains found in the field.

The printed and digital maps shall include the following:

- a. boundary of the test area
- b. sanitary sewer line segments tested
- c. location and boundary of blower setups
- d. locations of defects with defect number and photo of defect
- e. address of residences that did not smoke during testing (plumbing roof vent: negative) and residences that smoke in house
- f. ID numbers for manhole missing water-tight manhole inserts
- g. location of smoking storm sewer catches basins

The field documentation will include:

- a. sketched of the location and nature of each system defect
- b. pertinent information for prioritizing repair of the defects
- c. information needed to assess the best mitigation method
- d. color digital photographs will be taken to document defects during smoke testing
- e. location of defect will be measured from permanent objects (corner of house, light pole, etc.).

In addition to the standard documentation procedure, each smoke testing crew will be equipped with a computer tablet which is ‘blue-toothed’ to a GPS receiver. The crew can see their location on the downloaded ‘cloud-based’ map and as inflow sources are identified photographs will be taken to document each defect and an X, Y coordinate value will be assigned to each image. As each defect image is automatically uploaded to the ‘cloud-based’ map a defect type code will be attached to the image. Each inflow source or defect can then be displayed on the map and each defect type is assigned a different symbol/color/indicator. This form of documentation allows for comprehensive QA/QC of each completed smoke test and assurance that no defect is left unrecorded. The following is an overview of the required smoke testing process and reporting.

1. Field review the area selected area and note on the map all “hundred block” addresses.
2. Distribute smoke notice to all homes, businesses, schools, police and Fire & Rescue, etc. In addition, Fire & Rescue will be notified of any proposed smoke testing activities forty-eight to seventy-two hours prior to initiation.
3. During the initial field review, identify all types of businesses, specifically any doctors’ offices, hospitals, schools, retirement homes (communities), assisted living facilities (ALFs), or any other establishment that may need special consideration and handling during the actual smoke test. Strict consideration and coordination with customers who have sensitive needs must be adhered to, some of whom will not be included on any smoke testing schedule as the nature of their business, such as hospitals, is far too delicate.
4. Twenty-Four hours minimum must expire from the issuance of smoke testing notices to allow all affected to prepare for the testing. For special exceptions, such ALFs and persons with health problems living at home, etc., direct in person of telephone contact shall be made if at all possible.
5. On the day of the testing, the selected portion of the study area will be identified and all street names and related hundred block addresses will be given to the police and fire department/emergency personnel for the area where the testing will occur. UNDER NO CIRCUMSTANCES WILL THE AREA SELECTED FOR THAT DAY’S TESTING BE MODIFIED TO INCLUDE ADDITIONAL WORK UNLESS THE POLICE & FIRE DEPARTMENT/EMERGENCY PERSONNEL HAVE BEEN NOTIFIED FIRST. The name and ID number of the fire department person contacted will be documented on the appropriate form.

The fire department/emergency personnel will be provided the exact locations and specific time frames of where and when the tests will be performed.

6. Multi-day scheduling with one-time reporting to the police and fire department/emergency personnel will not be permitted.
7. The city's Project Manager will be notified on a daily basis with the same information.
8. Should the fire department/emergency personnel respond to the target area during the actual smoke testing, all testing will cease immediately and the Smoke Testing Team's field supervisor in charge will contact the fire unit responding to answer any questions that the fire department officer may have.
9. All testing activity will cease when any resident complains of smoke entering their establishment. Smoke Testing Team's field personnel will then attempt to isolate where the smoke is entering the establishment and make the occupant aware of what the problem may be. All defective plumbing found inside should be documented appropriately for future reference. The occupant will be advised to have the defect repaired by a licensed plumber.
10. During the actual smoke testing, Smoke Testing Team field personnel will scout the area for smoke escaping from ground sources, roof vents, storm drain structures, etc. All sources of Rainfall Dependent Infiltration/Inflow will be photographed, measured, drawn, and documented accordingly with addresses, data, and sketches. The smoke test form will identify which sewer segment is being tested by its component identification in the city's GIS database.
11. All defects encountered will also be recorded using handheld tablets 'blue tooth' to a GPS receiver. The tablet will have access to the city's wastewater collection system GIS which will be overlaid on a digital ortho map and the GPS unit will allow the smoke test team member to see his location on the map in real time and allow for the accurate recording of a defect's type and location. Each defect image taken will be geocoded to a specific location and the information will be stored electronically for future use.

It is understood that the city staff members may accompany the selected Contractor's field staff during the smoke testing initiative to gain a better understanding of how to quantify potential inflow volumes from the smoke defects recorded and how to compare the smoke testing defect results to the previously recorded flow data. It is further understood that the selected Contractor's staff will install cleanout plugs and storm water manhole inflow dishes (provided by the city) concurrently with the smoke testing operations. The selected Contractor will develop a 'Smoke Testing Results' spreadsheet that identifies each pipe section tested and the results of the test, whether positive or negative. A separate spreadsheet: 'Smoke Testing Defects', will be prepared that identifies all defects encountered during the smoke testing activity. This spreadsheet will contain a column which identifies the surface area associated with each defect, and if there is a need to conduct dye water testing/flooding.

406-3. DYE INVESTIGATION

The results of the smoke testing may not always clearly or positively indicate the source of a sanitary sewer interconnection or defect. Further investigation may be required to fully define the I/I sources or defects under the following conditions:

1. Smoke injected into the sanitary sewer is seen in storm sewer catch basins. This may be caused by defective catch basin laterals in the vicinity of the sanitary sewer (if the sanitary sewer has open joints, cracks or breaks). Dye testing may be needed to determine if the catch basin is connected to the sanitary sewer. CCTV (by others) of the sanitary sewer may be needed to identify the point of the smoke exfiltration.
2. Smoke does not freely pass from one manhole to the next, or vent from property's roof stack/ roof plumbing vent, during the sanitary sewer smoke testing. CCTV (by others) of the sanitary sewer/lateral may be needed to identify sewer blockages or pipe sags.

Upon completion of the initial smoke testing within a service area, the selected Contractor will submit a list of locations that require further investigation to the city. Upon approval from the city, the city may request the selected contractor to accompany a city diagnostic crew to further investigate the inconclusive smoke test results. Techniques employed by the city may include dye testing, CCTV inspections (by others) manhole/catch basin inspection, sewer line lamping (by others), and storm sewer cleaning (by others).

Where initial smoke test results warrant further investigation as approved by the city, a non-toxic dye approved by the city will be used to investigate specific potential interconnections. Contractor shall submit the SDS for all dyes used. Storm sewer cross-connections and area drains that are suspected of being connected to the sanitary sewer will be positively identified using the dye tracer procedure. Laterals suspected of having significant leaks or breaks will also be investigated. Field documentation, including sketches showing the location of all tests conducted and digital photographs, where feasible, will be used to record findings. Internal pipeline inspection will determine the exact source of the suspected interconnection and establish the best abatement option. The following identifies the dye water protocols to be implemented.

406-3.1. DYE WATER TRACING

Private/Public sector dye water tracing will be conducted by introducing a small quantity of liquid dye concentrate into suspect sources such as downspouts, area drains, patio drains, window well drains, and driveway drains, and then introducing a sufficient volume of clean water to locate the source's discharge point. During each tracing, sanitary sewers, storm drains, and curb lines located downstream of the sources shall be monitored for signs of dyed water. The quantity of dye concentrate and water used will vary depending on pipe size and the quantity of flow and debris in each line section. A report will be prepared for each location where dye water tracing has been performed. The report will identify where the dye water was introduced and its' susceptibility for entering the wastewater collection system. Photos will be taken of where the dye water is introduced and where it is recorded discharging into the downstream wastewater collection system manhole. CCTV inspection equipment (by others) will be utilized to identify exactly where the dye water is entering the wastewater collection system piping.

406-3.2. DYE WATER FLOODING

Dye water flooding results will be documented for each location where the storm drainage system is flooded. Each dye water flood report will identify the section of wastewater gravity piping being tested, the location(s) where the storm water system piping was isolated and flooded, photographs of each setup and CCTV inspection results (by others) identifying the location(s) where dye water was identified entering the wastewater collection system. The following information will also be documented; evidence of dyed water in manholes downstream from the ponding area, stream crossing, or other suspected sources where the dyed water is placed, and time of travel from contributing source to the manhole sampled, and the concentration of the dyed water observed;

The Field Inspection Procedures for Dyed Water Flooding are as follows:

1. A mixture of water and any approved dye coloring substance will be introduced to the identified source. Dye water team inspectors will be stationed immediately downstream on the local sanitary and storm sewer lines. Observations, whether positive or negative, will be documented appropriately. Whenever possible the dyed water point of exit will be documented by CCTV inspection equipment (by others).
2. Prior to any dye testing, the appropriate city staff shall be notified of the specific location of testing and what adjacent waterways may be affected when the dye water is released into the storm drainage system.

Fire hydrants used to supply the water source needed will be opened slowly and closed in the same manner. A flow restrictive device shall be used on the hydrant to prevent discoloration problems. Should the water be running cloudy or dirty after use, the fire hydrant shall be left open at a slow pace until the water clears. If long term draining is required, the Dye Water Team shall notify the city.

406-4. MEASUREMENT AND PAYMENT

Measurement shall be the number of linear feet smoke tested and each occurrence of dye water tracing and dye water flooding.

406-5. BASIS OF PAYMENT

Payment shall be based upon the unit price per linear foot for smoke testing as measured above and each occurrence of dye water tracing and dye water flooding, which shall be full compensation for all work described in this section of the specifications and shall include all materials, equipment, and labor necessary to perform the smoke and dye testing.

500 SERIES: POTABLE AND RECLAIMED WATER MAINS, FIRE LINES AND APPURTENANCES

501. SCOPE

The Contractor shall furnish all plant, labor, materials, and equipment to perform all operations in connection with the construction of potable water mains, fire lines, reclaimed water mains and appurtenances including clearing, excavation, trenching, backfilling and clean up. All materials identified and specified in this section shall be NSF 61 and ISO 9001 compliant.

502. MATERIALS

502-1. GENERAL

Materials, equipment, and supplies furnished and permanently incorporated into the project shall be of the best quality in every respect and shall be constructed and finished to high standards of workmanship. Materials shall be suitable for service intended, shall reflect modern design and engineering, and shall be fabricated in a first-class workmanlike manner. All materials, equipment and supplies shall be new and shall have not been in service at any time previous to installation, except as required in tests or incident to installation. Machined metal surfaces, exposed bearings and glands shall be protected against grit, dirt, chemical corrosion and other damaging effects during shipment and construction.

All materials shall be tested in accordance with the applicable Federal, ASTM or AWWA Specification and basis of rejection shall be as specified therein. Certified copies of the tests shall be submitted to the Engineer of Record with each shipment of materials.

Engineer of Record shall certify and submit all material test results to the city Project Manager within 10 calendar days of performing test(s).

502-2. PIPE MATERIALS AND FITTINGS

502-2.1. DUCTILE IRON PIPE

Ductile iron pipe shall conform to the requirements of ANSI/AWWA C151/ A21.51, latest revision. The minimum thickness class for underground pipe shall be Thickness Class 51 for 4-inch pipe or greater, 3" ductile iron water mains or service lines are not allowed, Thickness Class 50 for 6-inch through 12-inch pipe and Pressure Class 250 for 16-inch pipe and larger. Flanged pipe shall have a minimum thickness class of Class 53. Pipe thickness class or pressure class, wall thickness and working pressure shall conform to the following table:

Size	Thickness Class (TC) Pressure Class (PC)	Thickness (In.)	Rated Water Working Pressure (PSI)
4"	TC51	0.26	350
6"	TC50	0.25	350
8"	TC50	0.27	350
12"	TC50	0.31	350
16"	PC250	0.31	250
20"	PC250	0.33	250

SECTION IV – Technical Specifications

24"	PC250	0.37	250
30"	PC250	0.42	250
36"	PC250	0.47	250

Pipe larger than 8-inches in diameter or pipes which are deeper than 10-feet shall be ductile iron only, for open cut installations. The City Engineer reserves the right to require the use of ductile iron in sizes 4-inch through 12-inch when needed due to laying conditions or usage.

Pipe shall have a minimum rated water working pressure of 250 psi and shall be furnished in laying lengths of 20 feet or less, unless specifically shown otherwise on the Drawings. All piping and fittings shall be new and unused, no refurbished piping or fittings shall be accepted.

Ductile iron pipe shall be used for all hydrant installations, large meter sets 3" or larger and for fire line installations from the main to the backflow preventer.

Fittings: Fittings for bends, tees, crosses, etc. from 4-inch through 36-inch in size installed on ductile iron pipe shall be either mechanical joint, restrained joint or flanged joint as indicated on the Drawings and shall have a minimum working pressure of 250 psi. Fittings shall be cast ductile iron and shall conform to ANSI/AWWA C110, ANSI/AWWA C111 and ANSI/AWWA C153, latest revisions for flanged and mechanical joint pipe. Fittings for compact ductile iron cast fittings in accordance with ANSI/AWWA C153/A 21.53, latest revision with mechanical joint bells or ductile iron cast fittings in accordance with ANSI/AWWA C110/A 21.10, latest revision with mechanical joint bells. Fittings shall be coated and lined as indicated on the Drawings, in the manner specified below for ductile iron pipe. The rubber gaskets for flanged, mechanical, and push-on joints shall be as described below.

The working pressure minimum rating shall be 350 psi for 4-inch to 24-inch fittings. Fittings larger than 24-inch shall be pressure rated to 250 psi minimum. Fittings shall be designed to withstand without bursting a hydrostatic test of three times the rated water working pressure. All fittings shall have a date code cast into the fitting in addition to the pressure rating and material code. Ductile iron fittings shall be coated and lined in accordance with requirements of ANSI/AWWA C104/A21.4. Mechanical joint glands shall be ductile iron in accordance with ANSI/AWWA C111/A 21.11. When reference is made to ANSI/AWWA Standards, the latest revisions shall apply. Only those fittings and accessories that are of domestic (USA) manufacture shall be acceptable.

Push-On Joints: Push-on-joints shall be used for straight pipe lengths only. No fittings with push-on-joints shall be allowed. Pipe using push-on joints shall be in strict accordance with AWWA C111 and ANSI A21.11, latest revision. Jointing materials shall be provided by the pipe manufacturer and installation shall be in strict accordance with the manufacturer's recommended practice. The gaskets for push-on pipe joints shall be made of EPDM rubber. Push-on joints shall be as listed in the *City of Clearwater Approved Products List*, or an equal approved by the city.

Mechanical Joints: Jointing materials for mechanical joints shall be provided by the pipe and fitting manufacturer. Materials assembly, bolting and gaskets shall be in strict accordance with ANSI/AWWA C111 and ANSI/AWWA C110/ A 21.10 and ANSI/AWWA C153/ A 21.53, latest revisions. Tee head bolts and nuts for underground mechanical joint ductile iron fittings shall be manufactured of CORTEN, high strength, low alloy, corrosion resistant steel in accordance with ASTM A242, or an equal approved by the Engineer. The gaskets for mechanical joints shall be made of EPDM rubber.

Flanged Joints: Bolt circle and bolt holes for flanges shall be drilled and faced to match ANSI B16.1, Class 125, with any special drilling and tapping as required to insure correct alignment and bolting. All accessory hex-head bolts and nuts and full faced gaskets for each joint size shall be furnished as a flange accessory package.

1. Gaskets: Full face, Toruseal gaskets, or approved equal shall be used for flanged pipe connections. Gaskets shall be suitable for a water pressure of 350 psi at a temperature of 180F. The gaskets for flanged joints shall be made of EPDM rubber.
2. Bolts and Nuts for Flanges: Bolts and nuts for flanges shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts and ASTM A194, Grade 8M for nuts. The nuts shall have a hardness that is lower than that of the bolts and washers by a difference of 50 Brinnell hardness to prevent galling during installation.
3. Flanges shall be long-hub type screwed tightly on pipe by machine at the foundry prior to facing and drilling. Flange machine surfaces shall be coated with rust inhibitor immediately after facing and drilling. Field assembled screwed on flanges are prohibited.

502-2.1.1. MANUFACTURED RESTRAINED JOINTS FOR DUCTILE IRON PIPE

Restrained Pipe Joints and Fittings: Thrust restraint for buried piping shall be provided by restrained joints. Concrete thrust blocks shall not be acceptable. Pipe joints and fittings shall be restrained in accordance with the Drawings and the requirements of this Specification. It is intended that, at a minimum, all fittings shall be restrained. In cases where the calculated required length of restrained pipe is not evenly divisible by nominal laying lengths of pipe, the total required length of restrained pipe shall be rounded up to the next closest nominal length that is evenly divisible by the standard laying length.

- A. Manufactured Restrained Joints: Manufactured restrained joints shall be manufacturer's standard specifically modified push-on type joints with joint restraint provided by ductile iron retainer rings joined together by corrosion-resistant, high strength steel tee head bolts and nuts or with joint restraint provided by a welded-on retainer ring and a split flexible ring assembled behind the retainer ring. Gaskets for manufactured restrained pipe joints shall be made of EPDM rubber. Manufactured restrained joints shall be as listed as an equal approved by the city.
- B. Gripping-Type Gasket Restraint: Gripping-type gaskets may be used for ductile iron pipe 12-inches in size and smaller, when approved by the city. This type of restrained joint shall be the manufacturer's standard push-on type joint with joint restraint provided by a specially designed gasket with high strength stainless steel gripping elements which have sharp teeth on its inner surface for gripping the spigot end of the pipe joint. The gripping type gasket shall be made of EPDM rubber. The gripping type gasket manufacturer's joint restraint shall only be considered for use on pipe sizes from 4-inch to 12-inch. Gripping type gasket restraints shall be as listed in the *City of Clearwater Approved Products List*, or an equal approved by the city.
- C. Manufactured restrained joint pipe and fittings shall be ductile iron only and shall comply with applicable portions of this Specification. Manufactured restrained joints shall be capable of deflection during assembly. Deflection shall not exceed 50 percent of the manufacturer's recommendations.
- D. Tee head bolts and nuts for restrained joints shall be manufactured of CORTEN, high strength, low alloy, corrosion resistant steel in accordance with ASTM A242, or an equal approved by the Engineer.

502-2.1.2. ALTERNATE MECHANICALLY RESTRAINED JOINTS FOR DI PIPE

Thrust restraint for buried piping shall be provided by restrained joints. Concrete thrust blocks shall not be acceptable. When prior approval is obtained from the Engineer, ductile iron pipe and fittings with mechanical joints or ductile iron pipe with push-on joints may be restrained using a follower gland or ring which includes a restraining mechanism. Joint restraints shall have a working pressure rating of 350 psi for 3-inch to 16-inch ductile iron pipe, 250 psi for 18-inch to 36-inch ductile iron pipe, with a minimum pressure

rating safety factor of 2 to 1. The restraint shall be accomplished by multiple gripping wedges incorporated into a follower gland meeting the requirements of ANSI/AWWA C110/A21.10.

502-2.1.2.1. Restraints for Ductile Iron Pipe with Mechanical Joint Fittings

Joint restraints for ductile iron pipe to mechanical joint fittings shall be MEGALUG[®] Series 1100 restraints by EBAA Iron, or an approved equal listed in the *City of Clearwater Approved Products List*. When actuated during installation, the restraining device shall impart a multiple wedging action against the pipe wall, which increases resistance as internal pressure in the pipeline increases.

- A. The restrained joint shall maintain flexibility after installation. Glands shall be manufactured of ductile iron conforming to ASTM A536 and restraining devices shall be of heat-treated ductile iron with a minimum hardness of 370 BHN. The gland shall have standard dimension and bolting patterns for mechanical joints conforming to ANSI/AWWA C111 and C153, latest revisions. The restraining wedges shall have twist-off nuts to insure proper torquing.
- B. Tee head bolts and nuts shall be manufactured of corrosion-resistant, high strength, low alloy CORTEN steel in accordance with ASTM A242.
- C. No other retainer gland type device will be acceptable. After installation prior to backfilling, all parts of the joint restraint system shall be coated with coal tar epoxy equal to Carboline Bitumastic No. 300-M.

502-2.1.2.2. Restraints for Ductile Iron Pipe with Push-on Joints

Joint restraints for ductile iron push-on pipe joints 4-inch to 36-inch shall be constructed of ductile iron conforming to ASTM A536 and shall have a working pressure for 350 psi for 4-inch to 16-inch and 250 psi for 18-inch and larger fittings. Restraint shall be accomplished by a wedge action restraint ring on the spigot joined to a split ductile iron ring behind the bell and the two rings connected by restraint rods and nuts. Torque limiting twist off nuts shall be used to ensure proper actuation of the restraining wedges. The restraints shall be MEGALUG[®] Series 1700 restraint harnesses as manufactured by EBAA Iron or an approved equal.

- A. The restrained joint shall maintain flexibility after installation. Restraint rings shall be manufactured of ductile iron conforming to ASTM A536 and the ring restraining wedge devices shall be of heat-treated ductile iron with a minimum hardness of 370 BHN. The restraining wedges shall have twist-off nuts to insure proper torquing.
- B. Restraint rods and nuts shall be manufactured of corrosion-resistant, high strength, low alloy CORTEN steel in accordance with ASTM A242.
- C. No other restraint harness type device will be acceptable. After installation prior to backfilling, all parts of the joint restraint system shall be coated with coal tar epoxy equal to Carboline Bitumastic No. 300-M.

502-2.1.3. Ductile Iron Pipe Installed with Steel Casings

General: All pipe placed within steel casings shall be push-on joint ductile iron pipe restrained by the use of mechanical bell restraints as specified above in *Section 502-2.1.2.2*. The rods for the bell restraints shall be double nutted to prevent over-belling of the joint during push-in of the carrier pipe into the casing. The carrier pipe shall have properly sized casing spacers installed on the pipe so that the pipe will be centered within the casing. Each end of the casing shall be properly sealed to prevent the intrusion of soil, water, or debris within the casing itself. It shall be double sealed by brick and cement mortar and include a casing end seal with stainless steel bands as shown on in the engineering construction standards.

Cement-Mortar Interior Lining (Potable or Reclaimed Water): Ductile iron pipe, fittings, and specials shall be cement lined in accordance with ANSI/AWWA C104, latest edition, "Cement-Mortar Lining for Ductile Iron and Gray Iron Pipe and Fittings for Water". The cement lining shall have standard thickness

and, after curing, the lining shall have a seal coat of bituminous material in accordance with ANSI/AWWA C104/A21.4 80, latest revision and shall be listed by ANSI/NSF Standard 61 for potable water contact.

Pipe Labeling: Pipe manufacturer shall label in large legible lettering on the exterior of the pipe the type of pipe interior lining.

Exterior Coatings for Buried Pipe: Ductile iron pipe, fittings, and specials to be installed underground shall be coated on the exterior at the factory with one coat, 1 mil DFT, of asphaltic coating per AWWA C151, C110 and C153. All clamps, bolts, nuts, studs, and other uncoated parts of joints for underground installation shall be coated with coal tar epoxy prior to backfilling. Coal tar epoxy shall be equal to Carboline Bitumastic No. 300-M.

Exterior Coating for Exposed Pipe: Ductile iron pipe, fittings, and specials to be installed aboveground shall be furnished with a shop applied primer on the exterior. All above ground ductile iron pipe and fitting installations shall be painted in the field with an epoxy-epoxy-urethane system coating from an approved coating manufacturer, color: Safety Blue for potable water, Pantone Purple for reclaimed water or Safety Green for wastewater.

502-2.1.4. POLYETHYLENE ENCASEMENT FOR BURIED DUCTILE IRON PIPE

Polyethylene tube encasement shall be provided and installed for all buried ductile iron pipe segments and fittings for corrosion protection as specified herein. Both material and installation procedures shall be in accordance with ANSI/AWWA C105/ A21.5-10. Polyethylene encasement material shall be manufactured with UV inhibitors. The polyethylene encasement shall be color coded as follows:

- A. Potable Water Service – Blue Polyethylene Encasement.
- B. Reclaimed Water Service – Pantone Purple Polyethylene Encasement.
- C. Wastewater Service – Green Polyethylene Encasement.

The polyethylene encasement shall be a minimum of 8 mils thick and shall be certified by the manufacturer to provide suitable protection of pipe installation in corrosive soil.

All pipe joints shall consist of a minimum of one foot of polyethylene overlap onto the adjacent pipe at both ends. All overlap material shall be secured in place with at least two wraps of 1-inch wide x 8 mils thick polyethylene adhesive tape. Any slack liner material along the pipe barrel shall be taken up by folds secured in-place with adhesive tape. Repair any rips, punctures, or other damage to polyethylene with tape or by patching.

All valves, fittings and specialty items shall be jointed with proper overlaps and fastening as described above. Prepare openings for service taps, air-reliefs, etc., by making a cut in the polyethylene and temporarily folding back the edges. After installation is completed, replace the polyethylene and repair the cut with polyethylene adhesive tape.

Care shall be taken during backfilling so that no damage will occur to the polyethylene encasement. In general, backfilling shall be done in accordance with AWWA Standard C 600.

The Contractor shall install polyethylene encasement in accordance with all liner and pipe manufacturer recommendations.

Polyethylene encasement shall be required for below ground installations of ductile iron pipe and fittings where the installed ductile iron utility pipe will be located less than 10 feet from a gas main.

502-2.2. POLYVINYL CHLORIDE (PVC) PIPE

Each length of PVC pipe shall bear identification that will remain legible during normal handling, storage and installation such as the name or trademark of the manufacturer, the location of the manufacturing plant,

and the class or strength classification of the pipe. All PVC pipe shall bear the NSF-DW seal. Each length of pipe shall also bear and so designate the testing agency that verified the suitability of the pipe material for potable water service. The markings shall be plainly visible on the pipe barrel. This required identification shall be factory applied by the manufacturer. Pipe which is not marked clearly with the required identification is subject to rejection. All rejected pipe shall be promptly removed from the project site by the Contractor. PVC pipe is approved for underground installations only.

Polyvinyl Chloride (PVC) Pipe 4-inch through 8-inch shall be in accordance with ANSI/AWWA C900, DR18, latest revision and the American Society for Testing & Materials for the PVC Resin Compound conforming to ASTM Specification D1784. Pipe shall have gasketed integral bell ends and shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults. Pipe shall be designed for maximum working pressure of not less than 235 psi and with not less than a sustained hydrostatic pressure of 470 psi for a safety factor of 2 to 1 for AWWA C900 pipe.

Polyvinyl Chloride Pipe shall be manufactured to the same outside diameter (O.D.) as Ductile Iron Pipe only. Pipe larger than 8-inches in diameter or pipes which are deeper than 10-feet shall be ductile iron only. The City Engineer reserves the right to require the use of ductile iron in sizes 4-inch through 8-inch when needed due to laying conditions or usage.

Pipe dimension ratio, working pressure and laying length shall conform to the following table:

Size	Dimension Ratio (OD/Thick.)	Rated Water Working Pressure (PSI)	Laying Length (Ft)
4	18	235	20
6	18	235	20
8	18	235	20
12	18	235	20

Bell and Spigot Pipe Joints: Pipe joints shall be gasketed, push-on type made with integral bell and spigot pipe ends in accordance with ASTM D3139, latest revision. The bell shall consist of an integral thickened wall section designed to be at least as strong as the pipe wall. The bell shall be supplied with factory glued rubber ring gasket which conforms to the manufacturer's standard dimensions and tolerances. The gasket shall meet the requirements of ASTM F477 "*Elastomeric Seals (Gaskets) for Joining Plastic Pipe*" and shall be manufactured of EPDM elastomeric material. PVC pipe shall be approved by the Engineer and the Owner or approved equal.

Integral Pipe Color: All PVC pipe for potable water mains, reclaimed water mains and wastewater force mains shall be extruded or fabricated with an integral color in the PVC material. The integral color for the PVC pipe shall be as follows:

- A. Potable Water: PVC pipeline color - Blue.
- B. Reclaimed Water: PVC pipeline color – Pantone Purple
- C. Wastewater: PVC pipeline color – Green

The use of white or any other color pipe for potable water, reclaimed water or wastewater service shall be prohibited.

Fittings: Fittings for PVC pressure pipe shall be ductile iron fittings with restrained mechanical joint ends, linings and coatings as specified in *Section 502-2.1* for ductile iron fittings.

Restrained Joints for PVC Pipe: Thrust restraint for buried piping shall be provided by restrained joints. Concrete thrust blocks shall not be acceptable. Thrust restraints shall be used at all valves, tees, bends, and other fittings for the Restrained Joint PVC pipe and Push-on Joint PVC pipe. Where indicated on the Drawings, to prevent pipe joints and fittings from separating under pressure, pipe joints and fittings for PVC pipe shall be restrained as follows:

- A. PVC pipe bell and spigot push-on joints, adjacent to restrained fittings, shall be restrained using a harness type restraint device. The harness restraint shall be split to enable installation of the restraint after the spigot has been installed into the bell. The restraint unit shall consist of a split ring that fits behind the bell, a split restraint ring that installs on the spigot and a number of clamping bolts to connect the other two parts. The restraining device shall consist of multiple individually activated gripping wedges or a series of serrations to grip the pipe and maximize restraint capability in conjunction with a sufficient number of clamping bolts connecting the retainer on the bell side of the joint pipe to the restraint ring on the other side to hold the spigot. The restraining device and components shall be manufactured of high strength ductile iron meeting ASTM A536, Grade 65-42-10. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy CORTEN steel meeting the requirements of ASTM A242. The restraint device shall be the EBBA Iron MEGALUG[□] Series 1500 TD Restrainer or an equal.
- B. Mechanical joint fittings used with PVC pipe shall be restrained with the EBBA Iron MEGALUG[□] Series 2000 PV Restrainer or an equal approved. The restraining device shall consist of a retainer gland such that it can replace the standard mechanical joint gland and can be used with the standard mechanical joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21-53. The restraining device shall have a pressure rating equal to that of the PVC pipe on which it is used. Twist off nuts, sized same as the tee-head bolts shall be used to insure proper actuating of restraining devices. The restraining gland shall be manufactured of high strength ductile iron meeting ASTM A536, Grade 65-42-10. The tee head bolts and nuts, and the clamping bolts and nuts, shall be manufactured of corrosion resistant high strength, low alloy CORTEN steel meeting the requirements of ASTM A242.

502-2.2.1. RESTRAINED JOINT PVC PIPE (DIRECTIONAL BORE)

Restrained Joint PVC pipe and couplings used for directional bores shall be made from un-plasticized PVC compounds having a minimum cell classification of 12454-B, as defined in ASTM D1784 (latest edition). All compounds shall qualify for a Hydrostatic Design Basis (HDB) rating of 4000 psi for water at 73.4°F, in accordance with the requirements of ASTM D2837 (latest edition latest edition). Blue pipe (safety blue paint color) shall be supplied for the potable water system and purple pipe (pantone 522C paint color) shall be supplied for the reclaimed water system as specified in *Section 502-2.2*.

Nominal outside diameters and wall thickness of PVC pipe shall conform to the requirements of AWWA C900 for pipe sizes between 4 and 16-inches. Nominal outside diameters and wall thickness of 4" PVC pipe shall conform to the requirements of ASTM D2241 (latest edition). PVC pipe shall be furnished in sizes 4" (Pressure Rating 250 psi, DR17), 4" (Class 305, DR-14) and 6" and 8" (Class 235, DR-18). Pipe shall be furnished in standard laying lengths of 20 ft. + 1 in.

PVC pipe used for directional bores shall be joined using a restrained-joint coupling system or ring restraint with Rieber Gasket meeting the requirements of ASTM F477, latest edition. Pipe and/or couplings shall be designed as an integral system and shall be provided by a single manufacturer for maximum reliability and interchangeability. Assembled joints shall meet the leakage test requirements of ASTM D3139 (latest edition). No external pipe-to-pipe restraining devices which clamp onto or otherwise damage the pipe surface as a result of point-loading shall be permitted.

Maximum allowable axial jacking loads for the pipe shall be provided by the pipe manufacturer. The Contractor shall provide and utilize appropriate instrumentation that the Engineer shall monitor, to ensure that the jacking loads never exceed 80% of the maximum allowable axial jacking loads allowed by the pipe manufacturer. Only experienced personnel shall be used to install pipe. If used, coupling edges shall be beveled to reduce drag force when pipe is installed by directional bore or Micro tunneling. Assembly of joints shall be in strict accordance with the manufacturer's written instructions.

Manufacturer/Product: Certain Teed Certa-Lok C-900, no approved equal.

502-2.3. HIGH DENSITY POLYETHYLENE (HDPE) PIPE

This Section includes materials and methods of installation of high-density polyethylene pipe (HDPE) and fittings for water, reclaimed water, and wastewater utility use as required and as specified herein. For point repairs only if the flow cannot be stopped the use of stiffeners is allowed.

The high density, very high molecular weight polyethylene pipe shall be made from a HDPE material having a minimum material designation code of PE4710 and shall conform to AWWA C906, latest revision. The material shall meet the requirements of ASTM D3350 and shall have a minimum cell classification of PE445574C/E. In addition, the pipe shall be listed as meeting NSF-61. HDPE pipe shall have outside diameter sizes matching ductile iron pipe (DIPS) and shall have the minimum wall thickness and dimension ratio (DR) as shown on the Drawings for a particular installation. Minimum pressure ratings for HDPE pipe shall be 250 psi DR 9 and 200 psi for DR-11. The DR rating or the minimum pipe wall thickness of the pipe for a particular HDD installation shall be as called out on the Drawings. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed by pre-compounding in a concentration of not less than 2 percent.

The pipe manufacturer shall be listed and in good standing with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture the pipe. Pipe shall be manufactured by Performance Pipe (Chevron), JM Eagle or an approved equal.

HDPE pipe shall be manufactured and identified by color based on the type of utility service. HDPE pipe and tubing less than 6-inch in size shall be manufactured entirely in the required color. For HDPE pipe 6-inch and greater, color coding shall be accomplished either through an exterior surface entirely of the required color or through striping. The color coding shall be permanently co-extruded on the pipe exterior surface as part of the pipe's manufacturing process. The pipe shall be manufactured as one solid color per the applicable service color or shall be black in color with three (3) permanent solid color stripes, per the applicable service color, extruded into the piping material. The colored stripes shall appear on three (3) sides of the pipe, run the entire length of the pipe, and each stripe shall be no less than 1-inch wide. Painting HDPE pipe to accomplish color coding shall not be permitted. The pipe identification color coding based on the intended Type of Utility Service shall be as follows:

1. Sewer – green (safety green paint color)
2. Water – blue (safety blue paint color)
3. Reclaimed water – purple (pantone 522C paint color)

In addition to the identification color being co-extruded, HDPE Pipe shall have been continuously marked by the manufacturer with permanent printing with the following information at a minimum:

- A. Nominal Size (Inches).
- B. Dimension Ratio (DR).
- C. Pressure Rating (psi).
- D. Trade Name.
- E. Material Classification (PE4710).
- F. Plant, Extruder and Operator Codes.
- G. Resin Supplier Code.
- H. Date Produced; and
- I. HDPE pipe used for potable water mains shall bear the NSF Seal of Approval.

502-2.3.1. MECHANICAL JOINT ADAPTERS (MJ ADAPTERS)

Mechanical Joint Adapter Fittings shall have a material designation code of PE4710, and a minimum Cell Classification of PE445474C/E. Mechanical Joint Adapters can be made to ASTM D3261 or if machined, must meet the requirements of ASTM F2206. MJ Adapters shall have a pressure rating equal to the pipe

unless otherwise specified on the plans. Markings for molded or machined MJ Adapters shall be per ASTM D3261.

Where shown on the drawings, 4-inch and larger transitions to mechanical joint fittings and valves shall be ductile iron mechanical joint. Connection to the mechanical joint fittings shall be accomplished using a mechanical joint adapter kit. The mechanical joint adapter fitting shall be fused onto the pipe and shall result in a restrained joint with a pressure rating no less than 150 psi. The D.I./HDPE mechanical joint adaptor shall consist of:

1. A molded or fabricated HDPE mechanical joint transition fitting.
2. A mechanical joint rubber gasket fabricated of EPDM.
3. A mechanical joint restraining gland. The restraining gland shall be manufactured of high strength, ductile iron meeting ASTM A536, Grade 65-42-10.
4. The tee head bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy CORTEN steel, meeting the requirements of ASTM A242.

502-2.3.2. BUTT FUSION PROCESS AND INSTALLATION

The pipe shall be joined by the butt fusion procedure outlined in ASTM F2620 or PPI TR-33. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations and shall be butt-welded flush to the outside diameter of the pipe. Joints shall provide axial pullout resistance. Fusion joints shall be made by qualified fusion technicians per PPI TN-42. A record or certificate of training for the fusion operator must be provided to the Engineer that documents training to the fundamentals of ASTM F 2620.

All HDPE fusion equipment operators shall be qualified to perform pipe joining. Fusion equipment operators shall have current, formal training on all fusion equipment employed on the project and shall be certified by the pipe supplier/manufacturer. Training records for qualified fusion technicians shall be submitted to the Engineer for review. Training received more than two years prior to operation with no evidence of activity within the past 6 months shall not be considered current.

When the fusion machine operator is employed by the HDPE pipe and fusion machine supplier, the supplier shall maintain an ISO 9001 Certified Quality Management System.

Sections of HDPE shall be joined into continuous lengths on the job site above ground and butt fused in strict accordance with pipe manufacturer's recommendations. The finished pipe assembly shall be pressure tested prior to insertion underground.

All HDPE pipe shall be cut, fabricated, and installed in strict conformance with the pipe manufacturer's recommendations. Joining, laying, and pulling of polyethylene pipe shall be accomplished by personnel experienced in working with high density polyethylene pipe. The pipe supplier shall certify in writing to the Engineer that the Contractor is qualified to join, lay, and pull the pipe or representative of the pipe manufacturer shall be on site to oversee the pipe joining. Expenses for the representative shall be paid for by the Contractor.

The butt fused joint shall have a zero-leak rate under the following conditions:

- A. External pressure up to 60 psi from bentonite injection, slurry system operation, or groundwater head.
- B. Internal hydrostatic pressure testing of 150 psi.

The Contractor shall obtain from the pipe manufacturer a certificate of compliance to the effect that the pipe and fittings supplied for this Contract have been inspected at the plant and that they meet the requirements of these specifications. The Contractor shall submit these certificates to the Engineer prior to installation of the pipe materials. All pipe and fittings shall be subjected to visual inspection at time of delivery and before they are lowered into the trench to be laid. Joints or fittings that do not conform to these

specifications will be rejected and must be removed immediately by the Contractor. The entire product of any plant may be rejected when, in the opinion of the city, the methods of manufacture fail to secure uniform results, or where the materials used are such as to produce inferior pipe or fittings.

Each joint fusion shall be recorded and logged by an electronic monitoring device (data logger) affixed to the fusion machine. Joint data shall be submitted as part of the As-Built record information, in accordance with this Technical Specification.

Butt Fusion Machines: Only appropriately sized, and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following properties, including the following elements:

- A. **Heat Plate:** Heat plates shall be in good condition with no deep gouges or scratches within the pipe circle being fused. Plates shall be clean and free of any contamination. Heater controls shall properly function, and cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's recommendations.
- B. **Carriage:** Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
- C. **General Machine:** Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.
- D. **Data Logger:** The current version of the pipe supplier's recommended and compatible software shall be used. Protective case shall be utilized for the hand-held wireless portion of the unit. Data Logger operations and maintenance manual shall always be with the unit. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.
- E. **Joint Recording:** Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of thermoplastic pipe. The software shall register and/or record the parameters required by the manufacturer and these Specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

Required Auxiliary Equipment: Other equipment specifically required for the butt fusion process shall include the following:

- A. Pipe rollers shall be used for support of pipe on either side of the fusion machine.
- B. A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement and /or windy weather.
- C. Fusion machine operations and maintenance manual shall always be kept with the fusion machine.
- D. Facing blades specifically designed for cutting HDPE pipe.

The pipe shall be installed in a manner that does not exceed 70 percent of the recommended maximum bending radius of the pipe. When the pipe is installed by pulling in tension, 75 percent of the recommended Safe Pulling Force, according to the pipe supplier, shall not be exceeded.

Joint Fusion Bead Removal: Contractor shall trim and remove the butt fusion beads from the inside and the outside of the HDPE pipe at the butt fused joint following joint fusing. without disrupting pipe service. The restraints shall be manufactured by EBAA Iron Series 1500 or 1600 or approved equal.

502-2.4. PIPING IDENTIFICATION SYSTEM

502-2.4.1. EXTERIOR MARKINGS FOR BURIED PIPE

All ductile iron and polyvinyl chloride pressure pipelines installed by open cut shall receive a color-coded continuous self-adhesive vinyl tape, installed by the contractor, with the width and located as indicated below. Pipe tape striping shall be in the color required for the service as specified below.

A. **Tape Stripe Marking Locations:**

Up to 4-inch diameter pipe	(1 location)	3-inch wide tape placed at center-top of pipe.
6 to 16-inch diameter pipe	(2 locations)	6-inch wide tape placed on both sides, top half of pipe.
20-inch and larger diameter pipe	(3 locations)	6-inch wide tape placed on both sides' top half of pipe with a third stripe centered along top of pipe.

B. **Color of Tape Stripe Marking:**

Potable Water Marking Stripe Tape	Blue with Black or White Lettering, "POTABLE WATER MAIN" or similar wording.
Reclaimed Water Marking Stripe Tape	Purple with White or Yellow Lettering, "RECLAIMED WATER MAIN" or similar wording
Force Main Marking Stripe Tape	Green with Black or White Lettering, "WASTEWATER FORCE MAIN" or similar wording

502-2.4.2. LOCATION DETECTION WIRE:

- A. **Location Detection Wire for Open-Cut Pipeline Installations:** All ductile iron and polyvinyl chloride pressure pipelines installed by open cut shall be laid with two (2) strands of Location Detection Wire applied to the pipe. The detection wire shall be continuous, high strength copper clad steel (HS-CCS) 10 gauge AWG wire insulated with 30 mil thick high molecular weight – high density polyethylene (HMW-HDPE) insulation with a minimum break load of 684 pounds and specifically designed for use in open cut installations, equal to "1030-HS High Strength Tracer Wire" manufactured by Copperhead Industries, LLC, or an approved equal. Each wire shall be continuous with splices made only by spicing connectors manufactured by the wire manufacturer equal to "LSC1030C Snake Bite™ Locking Connectors" as manufactured by Copperhead Industries, LLC or an approved equal. The 2 wires shall be taped to the top of each joint of pipe with about 5-feet between each piece of tape, with a minimum of 3 taping locations for each 20-foot length of pipe. The tape used shall be 3M Scotch Rap All-Weather Corrosion Protection Tape, polyvinyl chloride backing with rubber adhesive, 4-inches wide or Engineer Approved Equal.

Following installation of the pipeline including backfill and compaction, the Contractor shall perform a second 12-volt DC electrical continuity test on each of the two (2) tracer wires.

- B. **Location Detection Wire for Horizontal Directional Drilling Pipeline Installations:** All polyvinyl chloride or HDPE pressure pipe installed by directional drilling methods shall be installed with three (3) insulated tracer wires. The three (3) tracer wires shall be attached at 120-degree locations around the pipe to help ensure continuity of at least one wire subsequent to the HDD installation. The tracer wire shall be continuous, extra high strength copper clad steel (EHS-CCS) 10 gauge AWG wire insulated with 45 mil thick high molecular weight – high density polyethylene (HMW-HDPE) insulation with a minimum break load of 2,032 pounds and specifically designed for use in directional drilling installations, equal to "1045-EHS Solo Shot EHS, Extra High Strength Tracer Wire" manufactured by Copperhead Industries, LLC, or an approved equal.

Continuity shall be maintained in the wire along the entire length of the pipe installed by HDD. No splices shall be allowed for each wire attached to the HDD pipeline unless approved by the city or the Engineer. If approved, permanent splices shall be made using wire connectors approved for underground applications with splices made only by splicing connectors manufactured by the wire manufacturer equal to “LSC1030C Snake Bite™ Locking Connectors” as manufactured by Copperhead Industries, LLC or an approved equal. If splices are approved by the city or the Engineer, all miscellaneous splicing components shall be furnished, installed, and tested by the Contractor and witnessed by the city or the Engineer.

At a minimum, the location detection wires shall be attached to the pipe with nylon wire ties, with ties located at 5-foot intervals, as shown in the Standard Details. The Contractor may suggest other methods of attachment, with the approval of the city or the Engineer.

Prior to installation of the pipeline into the bore hole, the Contractor shall perform a 12-volt DC electrical continuity test on each of the three (3) wires during the aboveground pressure test.

Following installation of the pipeline into the bore hole, the Contractor shall perform a second 12-volt DC electrical continuity test on each of the three (3) tracer wires. Failure of continuous continuity for at least one of the three tracing wires attached to the HDD pipeline, at the discretion of the city or the Engineer, shall be cause for rejection of the HDD installation, resulting in the abandonment and reinstallation of the directionally drilled pipeline.

The HDD tracer wires shall be spliced twelve (12) inches below grade to three (3) 10-gauge tracer wires, as specified above for open cut installations, and brought up in the valve boxes at the ends of each HDD line segment. The splices shall be made only by methods per the tracer wire manufacturer’s recommendations and by splicing connections manufactured by the tracer wire manufacturer. The splicing connectors shall be the “LSC1030C SnakeBite™ Locking Connector” as manufactured by Copperhead Industries, LLC, the Direct Bury Lug as manufactured by DryConn®, or an approved equal.

- C. **Color of Location Detection Wires:** The insulation color for the wire shall match the color for the pipes intended service as follows:
 1. Potable Water Mains – Blue Insulation.
 2. Reclaimed Water Mains - Pantone Purple Insulation.
 3. Wastewater Force Mains – Green Insulation.
- D. **Termination of the Location Detection Wires:** The tracer wires shall be secured to all valves, tees and elbows. It is to be installed at every valve box through a 2-inch PVC pipe to 18-inches above the top of the concrete slab. The 2-inch PVC pipe shall be the same length as the adjustable valve box, and the 2-inch PVC pipe shall be plugged with a 2-inch removable brass plug with recessed square nut

502-2.4.3. WARNING TAPE:

In addition, all underground pipelines installed by open-cut methods shall be buried with identification tape installed over the centerline of the pipe at a depth of 1.0 foot below finished grade. The identification tape shall be as follows:

- A. Identification tape shall be manufactured of reinforced polyethylene film with a minimum overall thickness of 4 mils and shall have a 0.35 mil thick magnetic metallic foil core. The tape shall be highly resistant to alkalis, acids, and other destructive agents found in soil. Tape width shall be 3-inches and shall have background color specified below, imprinted with black letters. Imprint shall be as specified below and shall repeat itself a minimum of once every 2-feet for entire length of tape. Tape shall be Terra Tape Sentry Line, or an approved equal.
- B. Tape background colors and imprints shall be in accordance with the following table:

Tape Imprint	Background Color	Imprint Color
“Caution – Potable Water Main Buried Below”	Blue	Black

“Caution – Reclaimed Water Main Buried Below”	Purple	White
“Caution – Wastewater Force Main Buried Below”	Green	Black

502-2.5. RESTRAINED JOINT COUPLINGS

Restrained Joint Pipe Couplings: Restrained joint pipe couplings used to join and restrain two pieces of plain end pipe shall be sized to suit the outside diameter of the pipe ends to be jointed with restrained ends. Transition couplings shall be used to join pipes of different outside diameters. Pipe couplings shall be bolted type with ASTM A536 ductile iron middle ring and end followers.

Coatings: All ductile iron parts of the coupling shall be coated on the interior and exterior with a fusion bonded thermosetting epoxy coating, applied electrostatically prior to assembly, and complying with AWWA C550 with a 12-mil nominal coating thickness. The coating shall be equal to Mega-Bond as manufactured by EBBA Iron, Inc., or an approved equal.

Gaskets: Gaskets for the coupling shall be wedge type manufactured of EPDM resilient rubber.

Bolts: Torque limiting nuts and gripping restraint wedges shall be manufactured of corrosion resistant, low alloy, high strength steel. Threaded restraint rods and hexagonal nuts shall be manufactured of high strength, Type 316 stainless steel. Bolts and nuts shall conform dimensionally to ANSI/AWWA C111, latest revision.

Approved Manufacturer: Restrained joint couplings shall be Series 3800 as manufactured by EBBA Iron, Inc., or an approved equal.

502-3. GATE VALVES

General: Gate valves shall open by turning to the left (counterclockwise), when viewed from the stem. When fully open, gate valves shall have a clear, unobstructed waterway equal to the nominal diameter of the pipe. All internal valve components shall be removable from the valve bonnet without removing the valve body from the pressure main. Operating nut or hand wheel shall have an arrow cast in the metal indicating the direction of opening. Each valve shall have the manufacturer's distinctive marking, pressure rating and year of manufacture cast on the body. Prior to shipment from the factory, each valve shall be tested by applying to it a hydrostatic pressure equal to twice the specified working pressure. Hydrostatic and leakage tests shall be conducted in strict accordance with ANSI/AWWA C500 or ANSI/AWWA C509, latest revisions, whichever is applicable. Only gate valve sizes 4-inch and larger shall be acceptable.

Large Gate Valves: Gate valves with nominal sizes from 4- to 12-inches shall conform to ANSI/AWWA C509, latest revision, and shall be designed for a minimum working pressure of 250 psi differential pressure with zero leakage. Gate valves with nominal sizes from 16- to 36-inches shall conform to AWWA C515, latest revision, and shall be designed for a working pressure of 250 psi differential pressure with zero leakage. Valves shall be ductile iron body resilient wedge type with Nitrile rubber O-ring stem seals. Stems shall be sealed with three (3) O-rings. The top two O-rings shall be replaceable with the valve fully open and subject to the full rated working pressure. O-rings in a cartridge shall not be allowed.

All cast ferrous components of the gate valve including the valve body, wedge, bonnet and stuffing box shall be constructed of ductile iron in conformance with ASTM A536. The valve stem shall be manufactured of manganese bronze in accordance with ASTM B763 and the wedge nut shall be manufactured of bronze in accordance with ASTM B584. The valve stem shall have an integral thrust collar; two-piece stem collars shall not be acceptable. The valve shall have Delrin thrust washers above and below the thrust collar to assist in the operation of the valve.

Valve wedge shall be symmetrical and constructed to assure uniform seating pressure between the wedge seat circumference and body seating surface, providing a complete seal at the rated pressure with flow from either direction. Resilient wedge of the valve shall be formed by a special corrosion and chloramine

resistant, EPDM synthetic elastomer which is permanently bonded to and completely encapsulates the ductile iron valve disc. The wedge nut shall be independent of the wedge and held in place on three sides by the wedge to prevent possible misalignment.

All bolting materials for buried gate valves shall be Type 304 stainless steel with hexagonal shaped heads with dimensions conforming to ANSI B18.2.1; metric bolting materials shall not be allowed. Gate valves shall be NSF 61 listed.

Resilient wedge type gate valves shall be as listed in the *City of Clearwater Approved Products List*, or an equal approved by the city.

Valve End Joints: All gate valves shall have either mechanical joints per ANSI/AWWA C111/A21.11 or restrained joints as specified above for ductile iron or PVC pipe for underground service, or flanged ends, Class 125 per ANSI B16.1, for above ground service or valves in vaults to fit the pipe run in which they are to be used. Gate valves installed on push-on joint pipe shall have mechanical joint ends unless otherwise specified.

Gate Valve Operators: Unless otherwise shown on the Drawings or specified herein, gate valves shall have non-rising stems. Buried gate valves shall be furnished with a 2-inch square AWWA standard nut operator with a valve box and cover. All buried gate valves shall be installed in the vertical position only. Buried gate valves 16-inches and larger in nominal size installed vertically shall be provided with a spur gear box, valve operator. The spur gear shall be an EXEECO 1S-5 to IS-10 spur gear, depending on the valve size, with a gear ratio not more than 2:1. Gate valves located aboveground or inside structures shall be furnished with a rising stem and a handwheel operator which shall have an arrow cast in the metal indicating the direction of opening. Gate valves used as isolation valves for double check valve backflow preventers for fire lines or reduced pressure back flow preventers shall be of the open screw and yoke (OS&Y) design with rising stems and with a handwheel operator.

Gate valves larger than 16-inches in nominal size shall be provided with a smaller gate valve bypass sized by the gate valve manufacturer.

Interior Valve Lining: Interior of the valve body shall be lined with a fusion bonded or thermo-setting epoxy coating in accordance with AWWA C550, latest revision. Lining shall be holiday-free, NSF 61 approved, with a minimum thickness of 16 mils. Surfaces shall be clean, dry, and free from rust and grease before lining.

Exterior Valve Coatings: All exterior surfaces of iron body gate valves shall be clean, dry, and free from rust and grease before coating. For buried service, the exterior ferrous parts of all valves shall be coated at the factory with coal tar epoxy with a minimum total finish dry film thickness of 20 mils. Prior to back filling, all uncoated nuts, bolts, glands, rods, and other parts of joints shall be coated in the field with coal tar epoxy equal to Carboline Bitumastic No. 300-M. For valves installed above-ground, the exterior ferrous parts of all valves shall be shop primed at the factory with one coat, minimum dry film thickness of 4 mils, of a rust-inhibitive universal epoxy primer. Primer shall be suitable for finish paint specified. Following installation, above-ground valves shall be finish painted in accordance with city Construction Standards.

Two Inch (2”) diameter gate valves or smaller are not allowed. These should be approved ball valves.

Three Inch (3”) diameter valves are not allowed.

502-4. VALVE BOXES

Furnish, assemble, and place a valve box over the operating nut for each buried valve. The valve box shall be designed to prevent the transmission of surface loads directly to the valve or piping.

Valve boxes shall be of the adjustable screw-type of suitable length with an interior diameter of not less than 5-1/4 inches. The valve boxes shall be manufactured of cast iron and shall be of the three-piece design

including a bottom section, middle section and top section with cover. The bottom section shall have a flange at the bottom having sufficient bearing area to prevent settling. The cast iron cover shall be cast with the applicable service; "WATER", markings for potable water mains, "RECLAIMED" marking for reclaimed water mains or "SEWER", markings for wastewater force mains. The top section shall be adjustable for elevation and shall be set to allow equal movement above and below finished grade.

The castings shall be manufactured of clean, even grain, gray cast iron conforming to ASTM A48, Class 30B for Gray Iron Castings; and shall be smooth, true to pattern, free from blow holes, sand holes, projections, and other harmful defects. The seating surfaces of both the cover and the top section shall be machined so that the cover will not rock after it has been seated.

The valve boxes shall be coated inside and outside with an asphaltic coating prior to machining, so that the machined seating surfaces will be free of any coating. Valve extension stems shall be provided for all buried valves when the valve operating nut is deeper than 3 feet below final grade.

Valve boxes and their installation shall be included in the bid price for valves. Refer to *City Standard Detail Index 402; Sheet 1 of 3 & Sheet 2 of 3* for potable water valve pad detail, and *City Standard Detail Index 502; Sheet 1 of 3 & Sheet 2 of 3* for reclaimed water valve boxes and pad detail.

502-5. HYDRANTS

Fire hydrants shall be dry barrel, break away type with 5-1/4-inch minimum main valve opening and shall comply with AWWA C502, latest revision, for a 150-psi working pressure and shall also be UL/FM listed. All hydrants shall be hydrostatically tested at the factory in accordance with AWWA C502, latest revision. Hydrants shall be the compression type, closing with line pressure. The main valve shall be solid encapsulated EPDM rubber. The main valve stem shall be Type 304 or higher-grade stainless steel and manufactured in two sections with a breakable coupling. The main hydrant valve shall open left (counterclockwise). Hydrants shall be fully bronze mounted with all working parts of bronze. Valve seat ring shall be threaded bronze and shall screw into a bronze retainer insert in the hydrant shoe, with O-rings to seal the barrel from leakage of water in the shoe. All interior working parts of the hydrant, including the seat ring, shall be removable through the top of the hydrant to allow repairs without disturbing the barrel of the hydrant after it has been installed. A dirt shield shall be provided to protect the operating mechanism from grit buildup and corrosion due to moisture. A thrust washer shall be supplied between the operating nut and stem lock nut to facilitate operation. The hydrant operating nut shall be of one-piece bronze or ductile iron construction and open counterclockwise. Operating nut shall be a No. 7, 1-1/2-inch, pentagonal shaped nut. The operating threads shall be totally enclosed in an operating chamber, separated from the hydrant barrel by a rubber O-ring stem seal and lubricated by a grease or an oil reservoir.

Fire hydrants shall be the traffic model breakaway type, with the barrel made in at least two sections bolted together, of ample length for 3-1/2 foot depth of bury with necessary extensions to place the safety break flange located approximately 2-inches above finished grade. Breakaway bolts shall not be approved. The fire hydrant shall be provided with a 6-inch mechanical joint epoxy lined elbow. The hydrant shall be provided with two, 2-1/2-inch hose nozzles and one, 4-1/2-inch pumper nozzle, all having National Standard hose threads. All nozzles shall have caps attached by stainless steel chains. Hose nozzle cap nuts shall be 1-1/2-inch AWWA standard pentagonal shape. Nozzles shall be of the tamper resistant, 1/4-turn type with O-ring seals or threaded into upper barrel. Nozzles shall be retained with a stainless-steel locking device.

The hydrant shall be cast with no drain or weep holes or the drain or weep holes shall be permanently plugged by the manufacturer. All bolts, nuts and studs for fire hydrants shall be Type 316 stainless steel. Fire hydrant base, lower barrel and 6-inch elbow shall be epoxy coated inside and outside. Upper barrel shall have an interior epoxy coating with the exterior coated with an epoxy primer and a two-part

polyurethane top coating. Fire hydrant upper barrel exterior colors shall have National Standard Yellow, UV resistant enamel, polyurethane, or fusion bonded epoxy.

Approved Fire Hydrants: Only those fire hydrants listed in the *City of Clearwater Approved Products List*, shall be used in extension to or replacement of the city's potable water system: Absolutely no substitutions for fire hydrants shall be allowed without the approval of the city Engineering Department.

All shipments of fire hydrants to the project site shall be palletized, securely anchored to the pallet(s) and delivered by delivery trucks with mechanical, motorized tailgates for receipt by the Contractor.

All hydrant assemblies shall be provided with an auxiliary 6-inch resilient seated gate valve for isolation so that the water to the hydrant may be shut off without the necessity of closing any other valve in the distribution system. Gate valves for fire hydrant installations shall be as specified above in *Section 502-2.7*. Piping used from the water main tee to the fire hydrant shall be 6-inch ductile iron pipe only. Ductile iron pipe shall be in accordance with *Section 502-2.1*.

The fire hydrant assembly shall be provided with anchoring hydrant fittings including a locked hydrant tee with split gland to provide the locking together of the entire assembly for joint restraint. Hydrants shall be restrained by using bolted mechanical swivel-type connecting joints from the hydrant tee through to the hydrant. Restraining mechanical joint glands on hydrants shall be used only where hydrant runout length precludes the use of swivel joint connectors. Restrained joints shall absorb all thrust and prevent movement of the hydrant. If used, mechanical restrained joints shall comply with *Section 502-2.1.2* of these Technical Specifications.

All fire hydrants shall be provided with a fiber mesh reinforced concrete shear pad with dimensions as shown in the Drawings.

Fire hydrants shall be located in the general location as shown on the Drawings. Final field location of all hydrants shall be as required by the city. All hydrants shall be located no less than 6-feet and no more than 10-feet from the curb or edge of pavement of the adjacent roadway.

Fire hydrants shall be located in a manner to provide complete accessibility and separated from any and all obstructions such as utility poles, posts, walls, etc., by a distance of at least five feet, measured from the centerline of the fire hydrant to the nearest physical feature, which may obstruct access or view of any fire hydrant, unless otherwise required by the Owner. All fire hydrants located within FDOT rights-of-way shall conform to FDOT clear zone requirements.

In order to minimize any inconvenience to property owners, new fire hydrants shall be installed at or near side property lines. Fire hydrants shall be installed such that the 4-1/2-inch pumper nozzle faces the street or driveway, unless otherwise directed by the Fire Department or the Owner's representative.

No hydrants shall be installed on the reclaimed water system unless approved by the city Engineering Department.

502-6. SERVICE SADDLES/ POLYETHYLENE SERVICE LINES

Service Saddles: Service saddles shall have ductile iron bodies in accordance with ASTM A536, latest revision, with double stainless-steel straps. Ductile iron body shall have a fusion bonded nylon coating with a minimum thickness of 12 mils. Straps shall be Type 304 stainless steel with premium grade Type 304 L stainless steel bolts and Type 304 stainless steel washers and nuts. The nuts shall be Teflon coated. The gasket material shall be an EPDM elastomeric compound resistant to degradation by oil, natural gas, acids, alkalis, most aliphatic fluids, and chloramines. The outlet of the saddle shall have female NPT threads. Approved service saddles shall be as listed in the *City of Clearwater Approved Products List*, or an equal approved by the city.

Service saddles shall be used on all service taps on water main pipelines 4-inch in size and larger. The largest service connection allowable for a 4-inch main shall be a 1-1/2-inch tapped connection. Service saddles shall be used on all 2-inch service connections on water main pipelines 6-inch and larger. Taps larger than 2-inch in size shall require using a tapping sleeve as specified below in *Section 502-12*.

Corporation Stops: Corporation stops shall be all bronze bodies with an all bronze ball and Teflon seats, in accordance with AWWA C800. Inlet and outlet threads shall have NPT threads. Corporation stops shall be as listed in the *City of Clearwater Approved Products List*, or an equal approved by the city.

Polyethylene Service Lines: All polyethylene service lines require stiffeners must be approved by the city and manufactured by Mars Company, Ocala, FL 34483. 3” service lines are not allowed. Refer to reclaimed water *Standard Detail Index 501 Sheet 2 of 2*.

502-7. BACKFLOW PREVENTERS

The city owns and maintains all backflow prevention devices that are installed within their system. Therefore, any and all devices must be purchased from the city and installed by city work forces.

Backflow prevention devices that are installed on customer's service lines at the point of delivery (service connection) shall be of a type in accordance with AWWA C511, latest edition for Reduced Pressure Principle Backflow Prevention Devices or AWWA C506, latest edition for Double Check Valve Assembly Backflow Prevention Devices.

Two (2) different types of backflow prevention devices are allowed. The type of device, and when required, shall be determined by the degree of hazard presented to the municipal water system from possible backflow of water within the customer's private system, as determined by the city Utility Engineering Department. The two types of backflow prevention devices allowed are:

1. **Double Check Valve Assembly Backflow Prevention Device:** a device composed of two (2) single, independently acting, approved check valves, including tightly closing shutoff valves located at each end of the assembly and suitable connections for testing the water tightness of each check valve.
2. **Reduced pressure principle backflow prevention device:** a device containing a minimum of two (2) independently acting, approved check valves, together with an automatically operated pressure differential relief valve located between the two check valves. The unit must include tightly closing shutoff valves located at each end of the device, and each device shall be fitted with properly located test cocks.
 - a. Reduced-pressure principle back flow preventers shall include an integral sensing system that will automatically open a relief valve whenever the differential pressure between the inlet supply and the reduced pressure zone drops to 2 psi. The relief valve shall remain open until a positive pressure differential of 2 psi is re-established. If pressure upstream of the first check valve drops to atmospheric or below, the relief valve shall remain fully open providing an internal air gap between the first check valve and the water level in the reduced pressure zone. The unit shall also be constructed such that any minor leakage of the second check valve will result in visible flow from the relief valve, even if the first check valve is totally disabled.

502-8. TAPPING SLEEVES AND LINESTOPS

Tapping valves and tapping sleeves shall be installed where shown on the drawings to make "wet" taps into existing potable water, reclaimed water mains or wastewater force mains. Tapping valves shall only be installed in the vertical position.

Tapping Sleeves for Taps 4-inch to 12-inch in Size: Fabricated all stainless steel body tapping sleeves to tap pipelines 4-inch through 30-inch in size with outlet tap sizes ranging from 4-inches through 12-inches, shall have heavy welded ASTM A240, Type 304 stainless steel body; Type 304 stainless steel bolts, Grade 8 per ASTM A194, epoxy coated; Type 304 stainless steel nuts, Grade 8 per ASTM A194, fluoropolymer coated; and a 3/4-inch Type 304 stainless steel test plug. The tapping sleeve, unless otherwise specified shall have a 18-8 Type 304 stainless steel outlet flange which meets the requirements of ANSI/AWWA C228 Class SD, ANSI 150 LB drilling recessed for tapping valve per MSS-SP60. The tapping sleeve gasket shall be EPDM rubber. Stainless steel body tapping sleeves shall be as listed in the *City of Clearwater Approved Products List*, or an equal approved by the city.

Mechanical Tapping Sleeves for Taps Larger Than 12-inch in Size: Mechanical joint split tapping sleeves shall be ductile iron capable of withstanding a 250-psi working pressure or the pipe rated working pressure, whichever is greater. The tapping flange for the sleeve shall have a groove that shall mate to the raised lip on the tapping valve flange. Gaskets shall be vulcanized EPDM resilient rubber material. All tapping connections for “size on size” taps shall utilize mechanical joint tapping sleeves only. The tapping sleeve shall be provided by the same manufacturer as the tapping valve. Bolts and nuts for the tapping sleeve split flange connection shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts and ASTM A194, Grade 8M for nuts. The nuts shall be fluoropolymer coated and have a hardness that is lower than that of the bolts and washers by a difference of 50 Brinnell hardness to prevent galling during installation. All interior and exterior surfaces of the mechanical joint split tapping sleeves shall be clean, dry, and free from rust and grease before coating. The interior and exterior surfaces of all mechanical joint split tapping sleeves shall be coated at the factory with fusion bonded or thermo-setting epoxy coating with a minimum total finish dry film thickness of 16 mils.

Tapping Valves: Tapping valves are special gate valves designed to mate to the flange of a mechanical tapping sleeve with a mechanical joint outlet connection. The tapping flange of the valve shall have a raised lip that will mate with the grooved flange of the tapping sleeve flange. The tapping valve shall have an oversized diameter waterway to allow passage of the tapping machine cutter assembly, without sustaining damage to the valve. Each tapping valve shall have the manufacturer's distinctive marking, pressure rating, the words “Ductile Iron” or “DI”, and year of manufacture cast on the body. Prior to shipment from the factory, each valve shall be tested by applying to it a hydrostatic pressure equal to twice the specified working pressure. Hydrostatic and leakage tests shall be conducted in strict accordance with ANSI/AWWA C509, latest revision. Resilient-seated type tapping valves shall be as listed in the *City of Clearwater Approved Products List*, or an equal approved by the city.

- A. Tapping valves with nominal sizes from 4- to 12-inches shall conform to ANSI/AWWA C509, latest revision, and shall be designed for a minimum working pressure of 250 psi. Tapping valves with nominal sizes from 16 inches and larger shall conform to AWWA C515, latest revision, and shall be designed for a working pressure of 250 psi. Valves shall be ductile iron body, resilient wedge type with Nitrile rubber O-ring stem seals. Stems shall be sealed with three (3) O-rings. The top two O-rings shall be replaceable with the valve fully open and subject to the full rated working pressure. O-rings in a cartridge shall not be allowed. All cast ferrous components of the tapping valve including the valve body, wedge, bonnet and stuffing box shall be constructed of ductile iron in conformance with ASTM A536. The valve stem shall be manufactured of manganese bronze in accordance with ASTM B763 and the wedge nut shall be manufactured of bronze in accordance with ASTM B584. The valve stem shall have an integral thrust collar; two-piece stem collars shall not be acceptable. The valve shall have Delrin thrust washers above and below the thrust collar to assist in the operation of the valve. Valve wedge shall be symmetrical and constructed to assure uniform seating pressure between the wedge seat circumference and body seating surface, providing a complete seal at the rated pressure with flow from either direction. Resilient wedge of the valve shall be formed by a special corrosion and chloramine resistant, EPDM synthetic elastomer which is permanently bonded to and completely encapsulates the ductile iron valve disc.

The wedge nut shall be independent of the wedge and held in place on three sides by the wedge to prevent possible misalignment. All bolting materials for buried tapping valves shall be Type 316 stainless steel, as specified below, with hexagonal shaped heads with dimensions conforming to ANSI B18.2.1; metric bolting materials shall not be allowed. Tapping valves shall be NSF 61 listed.

- B. **Tapping Valve Ends:** All tapping valves shall have a special flange with a raised lip to mate with the groove in the tapping sleeve flange and a mechanical joint end on the discharge side of the valve.
- C. **Tapping Valve Connection Bolting:** Bolts and nuts for the tapping valve flange connection shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts and ASTM A194, Grade 8M for nuts. The nuts shall be fluoropolymer coated and have a hardness that is lower than that of the bolts and washers by a difference of 50 Brinnell hardness to prevent galling during installation. Jointing materials for the mechanical joint valve end and the mechanical joint tapping sleeve ends shall be in strict accordance with ANSI/AWWA C111 and ANSI/AWWA C153, latest revisions. Tee head bolts and nuts for the mechanical joint ends shall be manufactured of CORTEN, high strength, low alloy, corrosion resistant steel in accordance with ASTM A242, or an equal approved by the Engineer and the Owner.
- D. **Tapping Valve Operators:** Tapping gate valves shall have non-rising stems and shall open by turning to the left (counterclockwise), when viewed from the stem. Tapping valves shall be furnished with a ductile iron 2-inch square AWWA standard nut operator with an arrow cast into the metal indicating the direction of opening. Tapping valves 16-inches and larger in nominal size shall be provided with a spur gear box, valve operator. The spur gear shall be an EXEECO IS-5 to IS-10 spur gear, depending on valve size, with a gear ratio not more than 2:1.
- E. **Interior Tapping Valve Linings:** The interior of the tapping valve body shall be lined with a fusion bonded or thermo-setting epoxy coating in accordance with AWWA C550, latest revision. Lining shall be holiday-free, NSF approved, with a minimum thickness of 16 mils. Surfaces shall be clean, dry, and free from rust and grease before lining.
- F. **Exterior Tapping Valve Coatings:** All exterior surfaces of tapping valves shall be clean, dry, and free from rust and grease before coating. The exterior ferrous parts of all tapping valves shall be coated at the factory with fusion bonded or thermo-setting epoxy coating with a minimum total finish dry film thickness of 16 mils. Prior to back filling, all uncoated nuts, bolts, glands, rods, and other parts of joints shall be coated in the field with two coats of coal tar epoxy equal to Carboline Bitumastic No. 300-M.

502-9. LINE STOPPING ASSEMBLIES

Specialty line stop fittings shall be used for applications where it is necessary to isolate a section of pipe without interrupting service. The Contractor shall provide a submittal which clearly identifies the materials used for line stop applications.

Sleeves used to line-stop existing mains shall be provided and installed at locations as shown on the Drawings or as required for construction of the new force main tie-in to an existing force main. Line-stopping sleeve shall be steel fusion epoxy coated body with stainless steel bolts, nuts, and washers. Contractor shall determine the outside diameter of the existing main prior to ordering sleeve. The back (bottom) section shall be solid and designed within an outside diameter range specific to the pipe it is being installed on. The front (top) section will also be full encirclement design with a welded installed nozzle and flange outlet.

Line stop fitting sleeves shall be the high strength type having a wide body, made of a minimum material strength of A-283 grade steel, ASTM A-36 Steel or equal, which conforms to and reinforces the pipe. The sleeve shall have as a minimum 7/8-inch wide gasket of Nitrile Butadiene Rubber (NBR, Buna-N) per ASTM D2000 with hydro activated lip, captured in a recessed groove around the outlet. Bolts, nuts and washers shall be 3/4-inch stainless steel 18-8 type 304. A 3/4-inch forged steel test outlet will be placed

into the nozzle branch outlet, at the factory, for the purposes of site pressure testing after the fitting has been installed around the pipe.

Tapping sleeves and line stops shall be installed in accordance with the manufacturer's recommendations for the specified model. The fitting may not be retrofitted in any way after being installed on the pipe. The Contractor shall be responsible for ensuring that the fitting is properly restrained.

The line-stopping equipment shall consist of a resilient sealing element, which shall be attached to and transported by a plug inserted perpendicularly into the pipe. The linear actuator shall extend and retract the Line-Stopper into and out of the pipe. When retracted from the pipe, the element and inserter shall be contained within the stopper housing.

The hollow cylindrical sealing element shall be molded of natural rubber. The lower interior chamber of the element shall be enlarged into a hemispherical cavity to allow symmetrical deformation into sealing conformity with the bore of the pipe. The linear actuator shall be hydraulic and shall have a self-contained hand operated pump. The actuator shall exert a force sufficient to perpendicularly deform the cylindrical element into axially symmetrical sealing contact with the bore of the pipe. Design of actuator shall provide adequate stroke and means to continually align the line-stop bullet stopping assemblies in sizes 4-inch thru 20-inch with pressure rating to 250 psig.

Equalization of pressure across the sealed element shall not be required to retract the element from the pipe. No equalization fittings shall be required downstream of the line-stopper.

Line-stopping equipment must be capable of function and acceptance of multiple stopper heads and shall be compatible with existing system fittings.

502-10. BLOW OFF HYDRANTS

Hydrant Blow offs are not allowed.

503. CONSTRUCTION

503-1. MATERIAL HANDLING

1. Care shall be taken in loading, transporting, and unloading to prevent damage to the pipe or fittings and their respective coatings. Pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be rolled off the carrier or dropped. Unloading shall be done by lifting with a forklift or crane using straps and a spreader bar. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.
2. Pipe shall be stored on level ground, preferably turf or sand, free of sharp objects which could damage the pipe. Stacking of the pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes. Pipe shall be stacked no higher than 6-feet high on the project site for safety reasons. Where necessary, due to ground conditions, the pipe shall be stored on wooden sleepers, suitably spaced and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.
3. The interior surfaces of valves and piping shall be kept free of dirt and debris.
4. Pipe and fittings which require the protection from UV, such as PVC or HDPE pipe, shall be covered and protected in accordance with manufacturer instructions.
5. Pipe shall be so handled that the coating and lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at their expense in a manner satisfactory to the Engineer.

6. In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.
7. All materials shall be subject to inspection and approved by the Engineer after delivery; and no broken, cracked, misshapen, imperfectly coated or otherwise damaged, unsatisfactory or defective material shall be used.
8. All material found during the progress of the work to have cracks, flaws, or other defects shall be rejected and promptly removed from the site.
9. If damage occurs to any pipe, fittings, valves, hydrants or water main accessories in handling, the damage shall be immediately brought to the Engineer's attention. The Engineer shall prescribe corrective repairs or rejection of the damaged items.

503-2. PIPE LAYING

503-2.1. INSPECTION PRIOR TO INSTALLATION

All pipe, fittings, valves, and other material shall be subject to inspection and approval by the Engineer and the City after delivery and prior to installation. If damage occurs to any pipe, fittings, valves, hydrants or accessories in handling, the damage shall be immediately brought to the Engineer's attention. The Engineer shall prescribe corrective repairs or rejection of the damaged items. No broken, cracked, imperfectly coated, or otherwise damaged or unsatisfactory material shall be installed. When a defect or crack is discovered, the injured or defective piece shall not be installed and shall be removed from the project site. All homing marks shall be checked for proper length to not allow a separation or over homing of connected pipe. Homing marks incorrectly marked on pipe shall result in rejection of pipe and removal from the site at the Contractor's expense.

503-2.2. GENERAL INSTALLATION REQUIREMENTS

General: Excavation, backfill, and compaction shall conform to the provisions of *Section 201-2. – Excavation, Backfilling and Compaction for Utilities*. Upon satisfactory installation of the pipe bedding material as specified in *Section 201-2. – Excavation, Backfilling and Compaction for Utilities*, a continuous trough for the pipe barrel and recesses for the pipe bells or couplings shall be excavated by hand digging. When the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure will be exerted on the pipe joints from the trench bottom.

Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient performance of the work. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench piece by piece by means of a derrick, ropes, or other suitable tools or equipment in such a manner as to prevent damage to materials and protective coatings and linings. Under no circumstances shall materials be dropped or dumped in the trench.

Pipe, fittings, valves, and accessories shall be installed as shown or indicated on the Drawings. All joint lubricant compounds shall be NSF approved.

Water in Excavations: Water shall not be allowed in the trenches while underground pipes are being laid and/or tested. All pipe shall be laid “in the dry”. Installation of potable water pipes, reclaimed water pipes or wastewater force main pipes shall not proceed in the trench until the trench has been properly dewatered and prepared. Refer to *Section 203, Dewatering* for dewatering requirements for the installation of pipelines. No pipe shall be laid when, in the opinion of the Engineer, trench conditions are unsuitable. Water shall not be allowed in the trenches while the pipes are being laid and/or tested. The Contractor shall not open more trench than the available pumping facilities are able to dewater the trench to the satisfaction of the Engineer or the city’s Inspector. The Contractor shall assume responsibility for legally disposing of all water so as not to injure or interfere with the normal drainage of the area in which he is working. In no case

shall the pipelines being installed be used as drains for such water, and the ends of the pipe shall be kept properly and adequately plugged during construction by the use of approved stoppers and not by improvised equipment. All necessary precautions shall be taken by the Contractor to prevent the entrance of mud, sand, or other obstructing matter into the pipelines. If on completion of the work any such materials have entered the pipelines, it must be cleaned as directed by the Engineer and the city's Inspector so that the entire system will be left clean and unobstructed. The Contractor shall not leave trenches open overnight.

Pipe Bedding: The Contractor shall provide pipe bedding material in accordance with the Standard Details on the Drawings and *Section 201-2. – Excavation, Backfilling and Compaction for Utilities*. The Contractor shall hand-grade bedding to proper grade ahead of pipe laying operation. Bedding shall provide a firm, unyielding support along the entire pipe length. If the trench has been excavated below the required depth for pipe bedding material placement, the Contractor shall fill the excess depth with pipe bedding material to the proper grade. The Contractor shall excavate bell holes at each joint to permit proper assembly and inspection of the entire joint.

Pipe Cradle: Upon satisfactory installation of the pipe trench as specified in *Section 201-2. – Excavation, Backfilling and Compaction for Utilities* and the pipe bedding, a continuous trough for the pipe barrel and recesses for the pipe bells or couplings shall be excavated by hand digging so that when the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure will be exerted on the pipe joints or pipe bell from the trench bottom.

Cleanliness: Mud, silt, gravel, and other foreign material shall be kept out of the pipe and off the jointing surface. The interior of the pipes shall be thoroughly cleaned of all foreign material before being gently lowered into the trench and shall be kept clean during laying operations by means of plugs or other methods accepted by the Engineer and the city. During suspension of work for any reason at any time, a suitable watertight plug shall be placed in the end of the pipe last laid to prevent mud or other foreign material from entering the pipe.

Connections to Existing Utilities: All connections to existing piping systems shall be made as shown or indicated on the Drawings after consultation and cooperation with the city Utility Department. Some such connections may have to be made during off-peak hours (late night or early morning).

Pipe Joint Deflection: Whenever it is desirable to deflect pipe joints to avoid obstructions or to maintain required alignment, the amount of the joint deflection shall not exceed 50 percent of the maximum limits allowed by the pipe manufacturer for ductile iron pipe. No bending or joint deflection of PVC pipe shall be permitted at any time. Changes in horizontal and vertical alignment of PVC pipe shall be achieved by use of fittings only.

Pipe Installation: In preparation for pipe installation, placement (stringing) of pipe should be as close to the trench as practical on the opposite side of the trench from the excavated material.

All pipe and fittings shall be carefully examined for cracks and other defects while suspended above the trench immediately before installation in final position. Spigot ends shall be examined with particular care as this area is the most vulnerable to damage from handling.

Pipe laying shall proceed with the bell ends of the pipe pointing in the direction of the work progress unless directed otherwise by the Engineer. Where pipe is laid on a grade of 10 percent or greater, the laying shall start at bottom and shall proceed upward with the bell ends of the pipe pointing upgrade. Before pipe is joined, gaskets shall be cleaned of all dirt and stones and other foreign material. The spigot ends of the pipe and/or pipe gaskets shall be lubricated lightly with an NSF approved lubricant as specified by the pipe manufacturer and approved by the Engineer and the city. No sulfur based joint compound shall be used. Sufficient pressure shall be applied to the pipe to properly seat the spigot end into the bell of the previously laid pipe. Any damage to the pipe due to over-exertion shall be repaired at the Contractor's expense. All damaged pipe shall be removed for the Project site.

Pipe and fittings shall be laid accurately to the lines and grades indicated on Drawings or required. The depth of cover over the pipeline shall vary to provide uniform gradient or slope to the pipe, whether grading is completed or proposed at time of pipe installation. Where grades for the pipeline are not indicated on the Drawings, maintain a uniform depth of cover with respect to finish grade.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Precautions shall be taken to prevent dirt from entering the joint space.

All pipe laid shall be retained in position to maintain alignment and joint closure until sufficient backfill has been completed to adequately hold the pipe in place. Care shall be taken to ensure a good alignment both horizontally and vertically and to give the pipe a firm bearing along its entire length. Any pipe which has its grade or joint disturbed after laying shall be taken up and relayed.

All pipe and fittings shall be cleared of sand, dirt, and debris before laying. All precautions shall be taken to prevent sand, dirt, or other foreign material from entering the pipe during installation. If necessary, a heavy, tightly woven canvas bag of suitable size shall be placed over each end of the pipe before lowering into the trench and left there until the connection is made to the adjacent pipe. Any sand, dirt, or other foreign material that enters the pipe shall be removed from the pipe immediately. During pipe laying operations, no debris, tools, clothing or other materials shall be placed into the pipe interior. Interior of all pipe and fittings shall be kept clean after installation until accepted in the complete Work.

Any time that pipe installation is not in progress, the open ends of pipe shall be closed by a watertight plug or other method approved by the Engineer and the city Inspector. Plugs shall remain in pipe ends until all water is removed from the trench. No pipe shall be installed when trench conditions are unsuitable for such work, including standing water, excess mud, or rain.

Thrust Restraint:

- A. General: Thrust restraint shall be accomplished by piping restrained joints or mechanical restraining devices.
- B. Required Length of Restrained Joints: The length of restrained joints required shall be in accordance with the lengths shown on the Plan and Profile Drawings. The restrained joint lengths listed in the Restrained Joint Pipe Tables in the Drawings are absolute minimum lengths required and may not reflect the actual length of restrained joints required for a particular fitting arrangement or situation.
- C. Concrete Trust Blocks: Concrete thrust blocks shall not under any circumstances be allowed on the Project for thrust restraint at fittings.
- D. Concrete Trust Collars: Concrete thrust collars shall be used under extraordinary circumstances when approved by the Engineer and the city. If thrust collars are used, they shall conform to the details shown on the Drawings and shall be constructed of Class I concrete, which shall have a minimum compressive strength of 3,500 psi at 28 days. No pipeline work shall be accomplished adjacent to a thrust collar until the concrete has reached its full compressive strength and can handle the required thrust restraint.

Initial Backfill:

- A. After pipe has been laid, inspected, and found satisfactory, sufficient backfill shall be placed along the pipe barrel to hold the pipe securely in place while conducting the preliminary hydrostatic test. No backfill shall be placed over the joints until the preliminary test is satisfactorily completed, leaving them exposed to view for the detection of visible leaks.
- B. Upon satisfactory completion of the preliminary hydrostatic test, backfilling and compaction of the trench shall be completed.

Location Detection Wire: Refer to the city Standard Detail Drawings for wire location and installation notes. Location Detection Wires shall be installed for all potable water mains, reclaimed water mains and wastewater force mains. For open cut installation the two (2) detection wires shall be attached generally at the three o'clock and nine o'clock positions on the pipe with nylon pipe straps or tape located at 5-foot intervals for each 20-foot length of pipe. The wire shall be installed through valve boxes, valve vaults, air release valve enclosures, etc., and provide sufficient excess (12-inches minimum) such that a loop in the wire can be raised above ground level. An energy source shall be attached to each of the wires to energize each wire to facilitate location of the wire and pipe using a metal detector. Prior to acceptance, the Contractor shall demonstrate to the Engineer and the city Inspector that each of the wires is continuous and unbroken through the complete run of the pipe by performing a continuity test of the 10 gauge location detection wires for the entire length of the potable water main, the reclaimed water main or the wastewater force main at each valve test station box. The test shall also include energizing each of the wires and locating the entire run of pipe with the Engineer and the city Inspector present.

Underground Identification Tape: Install a continuous underground utility identification tape for all underground potable water mains, reclaimed water mains and wastewater force mains installed by open-cut methods. The identification tape shall be installed over the centerline of the pipe at a depth of 12-inches below finished grade.

Aboveground and Exposed Piping: Piping shall be cut accurately to measurements established at the job site and shall be worked into place without springing or forcing, properly clearing all equipment access areas and openings. Changes in sizes shall be made with appropriate reducing fittings. Pipe connections shall be made in accordance with the details shown and manufacturer's recommendations. Open ends of pipelines shall be properly capped or plugged during installation to keep dirt and other foreign material out of the system. Pipe supports and hangers shall be provided where indicated or as required to ensure adequate support of the piping. All above ground piping shall be painted with the appropriate color.

503-2.3. INSTALLATION OF DUCTILE IRON PIPE

Handling and Cutting Pipe:

- A. Care shall be taken in handling, cutting, and laying ductile iron pipe and fittings to avoid damaging the pipe and interior cement mortar lining, scratching, or marring machined surfaces, and abrasion of the exterior pipe coating. All cracked pipe and fittings shall be removed at once from the Work.
- B. Pipe cutting shall be done by skilled workmen in a neat workmanlike manner without creating damage to the pipe and interior lining and to leave a smooth end at right angles to the axis of the pipe. Cut ends shall be square and rough edges of ductile iron pipe shall be ground smooth. For push-on joint connections, the cut end shall be beveled to prevent gasket damage during joint assembly. Interior lining and exterior coatings of the pipe shall be repaired at cut ends per the manufacturer's instructions prior to joint assembly.

Laying Ductile Iron Pipe and Fittings:

- A. **Bedding for Ductile Iron Pipe:** Minimum bedding requirements shall be Type 3 as defined in ANSI/AWWA C600, latest revision. Provide proper bedding required, in accordance with thickness class of pipe being laid, restrained joints required and depth of cover. At a minimum the pipe shall be bedded in compacted 4-inch thick select fill and backfilled and compacted to the top of the pipe to a minimum of 95% Modified Proctor. Proper pipe laying conditions shall be in accordance with ANSI/AWWA C150 and C151, latest revisions, and ANSI/AWWA C600, latest revision.
- B. All ductile iron pipe and fittings shall be laid in accordance with American Water Works Association Standard *ANSI/AWWA C600*, latest revision, entitled "*Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances*", with the following sections specifically applying:

1. Section 3.3 - Pipe Installation.
 2. Section 3.4 - Joint Assembly.
- C. Polyethylene tube encasement shall be installed for all buried ductile iron pipe segments and fittings for corrosion protection. Installation procedures shall be in accordance with *AWWA C105/ANSI A21.5-10*, latest revision, entitled *Polyethylene Encasement for Ductile Iron Pipe Systems, Section 4.4 - Installation*.

Ductile Iron Pipe Joints:

- A. General: The joints of all pipelines shall be made leak tight. The particular joint used shall be approved by the Engineer and the city Inspector prior to installation. Where shown on the Drawings or where, in the opinion of the Engineer or the city Inspector, settlement or vibration is likely to occur, all pipe joints shall be bolted mechanical joint type with mechanical restraints, push-on joints with mechanical restraints or manufactured restrained joint type as specified above, or as indicated on the Drawings.

All lumps, blisters, and excess coating shall be removed from the bell and spigot end of each pipe, and the outside of the spigot and the inside of the bell shall be wire brushed and wiped clean and dry and free from oil and grease before the pipe is laid. Pipe joints shall be made up in accordance with the manufacturer's recommendations.

- B. Mechanical Restrained Joints: All types of mechanical joint and push-on joint pipes with mechanical restraints shall be laid and jointed in full conformance with manufacturer's recommendations, which shall be submitted to the Engineer and the city Inspector for review and approval before work is begun. Only specially trained and skilled workmen shall be permitted to makeup mechanical restrained joints. Torque wrenches, set as specified in AWWA Standard C111, shall be used; or spanner type wrenches not longer than specified therein may be used with the permission of the Engineer and the city Inspector. The gasket shall be inserted, and the joint surfaces cleaned and lubricated with soapy water before tightening the bolts to the specified torque.
- C. Manufactured Restrained Joints: Manufactured restrained joints shall be provided where indicated on the Drawings. Joint assembly shall be made in strict accordance with the manufacturer's instructions, which shall be submitted to the Engineer or the city Inspector for review and approval before commencing work.
- D. Flanged Joints: Flanged joints shall be made up by inserting the gasket between the flanges. The threads of the bolts and the faces of the gaskets shall be coated with suitable lubricant immediately before installation. Joints shall be fitted so that the contact faces bear uniformly on the gasket.
1. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing and lubricate bolts with oil and graphite.
 2. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
 3. Execute care when tightening joints to prevent undue strain upon valves, pumps, backflow preventers and other equipment.

If flanges leak under pressure testing, loosen, or remove the nuts and bolts, reset or replace the gasket, re-install or re-tighten the bolts and nuts, and re-test the joints. Joints shall be watertight; no leaks shall be allowed.

503-2.4. INSTALLATION OF POLYVINYL CHLORIDE (PVC) PIPE

Storage and Handling of PVC Pipe: PVC pipe shall be delivered to the site in unbroken bundles packaged in such manner as to provide protection against damage. When possible, pipe should be stored at the job site in the unit packages until ready for use. Packaged units shall be handled using a forklift or a spreader bar with fabric straps. Packaged units shall not be stacked at the job site higher than two units high.

When it is necessary to store PVC pipe for long periods of time, exposure to direct sunlight shall be prevented by covering the pipe with an opaque material. Adequate air circulation above and around the pipe shall be provided as required to prevent excessive heat accumulation. PVC pipe shall not be stored close to heat sources of hot objects such as heaters, fires, boilers, or engine exhaust. Pipe gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone, oil, and grease. The interior and all sealing surfaces of pipe, fittings, and other appurtenances shall be kept clean and free of dirt and foreign matter.

Care shall be taken in handling and laying pipe and fittings to avoid severe impact blows, crushing, abrasion damage, gouging, or cutting. Pipe shall be lowered, not dropped, from trucks or into trenches. All cracked, damaged, or defective pipe and fittings, or any length of PVC pipe having a gouge, scratch, or other permanent indentation of more than 10 percent of the wall thickness in depth, shall be rejected and removed at once from the Work and replaced with new acceptable pipe.

Field Cutting PVC Pipe: Field cutting of pipe shall be done in a neat workmanlike manner without creating damage to the pipe. The pipe shall be cut square with a fine-toothed hand or power saw or other cutter or knife designed for use with plastic pipe. Prior to cutting, the pipe shall be marked around its entire circumference or a square-in vise shall be used to ensure the pipe end is cut square. Remove burrs by smoothing edges with a knife, file, or sandpaper.

Field Cutting Bell and Spigot PVC Pipe: Bevel the cut end of the pipe using a pipe beveling tool, wood rasp, or portable sander to prevent damage to the gasket during joint assembly. A factory-finished beveled end should be used as a guide to ensure proper beveling angle and correct depth of bevel. Round off any sharp edges on the leading edge of the bevel with a knife or file. The Contractor shall provide a seat homing mark on the field cut pipe in accordance with the pipe manufacturer's written instructions.

Laying PVC Bell and Spigot Pipe:

- A. **Pipe Bedding:** Bedding for PVC pipe shall be as specified in *Section 201-2. – Excavation, Backfilling and Compaction for Utilities* using granular pipe bedding material.
- B. All PVC pipe shall be laid in accordance with the pipe manufacturer's published installation guide, the *AWWA Manual of Practice No. M23 "PVC Pipe - Design and Installation"* and the Uni-Bell Plastic Pipe Association installation recommendations.

PVC Pipe Joint Assembly for Rubber Gasketed Bell and Spigot Pipe:

- A. The PVC bell and spigot joint shall be assembled in accordance with the pipe manufacturer's installation instructions, ASTM D2774, and AWWA Manual M23. Clean the interior of the bell, the gasket, and the spigot of the pipe to be jointed with a rag to remove any dirt or foreign material before assembling. Inspect the gasket, pipe spigot bevel, gasket groove, and sealing surfaces for damage or deformation.
- B. Lubricate the spigot end of the pipe with an NSF approved lubricant supplied or specified by the pipe manufacturer for use with gasketed PVC pipe in potable water systems. The lubricant should be supplied as specified by the pipe manufacturer and shall be NSF approved. After the spigot end is lubricated, it must be kept clean and free of dirt and sand. If dirt and sand adhere to the lubricated end, the spigot must be wiped clean and re-lubricated.
- C. Insert the spigot into the bell so that it contacts the gasket uniformly. Align the pipe sections and push the spigot end into the bell until the manufacturer's reference mark on the spigot is flush with the end of the bell. The pipe should be pushed into the bell using a bar and wood block. The joint shall not be assembled by "stabbing" or swinging the pipe into the bell, nor shall construction machinery be used to push the pipe into the bell. After joining the pipe, a metal feeler gauge shall be used to verify that the joint gasket is properly located.
- D. If undue resistance to insertion of the spigot end is encountered or if the reference mark does not reach the flush position, disassemble the joint and check the position of the gasket. If the gasket is twisted or pushed out of its seat, inspect the components, repair, or replace damaged items, clean

the components, and repeat the assembly steps. Be sure the pipe is in proper alignment during assembly. If the gasket was not out of position, check the distance between the spigot end and the reference mark and relocate the mark if it is out of position.

- E. Restrained joints for PVC pipe shall be provided where indicated on the Drawings. Joint assembly shall be made in strict accordance with the joint restraint manufacturer's instructions, which shall be submitted to the Engineer and the city for review and approval before commencing work.

503-2.5. DIRECTIONAL BORING INSTALLATION

The work of this Section includes all labor, machinery, construction equipment and appliances required for installation of high-density polyethylene (HDPE) pipe or Certa-Loc PVC pipe below the ground using directionally controlled horizontal drilling equipment and methods. All directional boring methods and equipment shall be approved by the Engineer and the city before any work shall be permitted. All directional boring and pipe installation methods shall be performed in a good workmanlike and safe manner.

Horizontal Directional Drilling (HDD) is a construction method consisting of drilling a small diameter pilot hole within the designed tolerances for radius requirements, followed by enlargement of the hole by back reaming to accommodate the utility pipeline.

503-2.5.1. GENERAL REQUIREMENTS

The overall work scope shall include, but not be limited to steerable directional boring equipment, boring pits and equipment, sheeting, location signs as required, maintenance of traffic and miscellaneous appurtenances to complete the entire Work as shown on the Contract Drawings, and restoration. Directional boring operations shall be performed within the right-of-way and/or easements shown on the Drawings.

The HDD Contractor shall assume full responsibility for his methods of construction, the stability and accuracy of the drilled and reamed hole and pits constructed by him, and all costs for damages resulting from any failure thereof and be solely responsible for the safety of the pits and related structures, and personnel engaged in underground construction throughout the duration of the work.

The general dimensions, arrangement and details for the drilled pilot hole and entry and exit pits to be constructed shall be as indicated on the approved Shop Drawings.

Methods of excavation, equipment and procedures for the HDD operation and pits shall be selected to provide adequate working space and clearances for the work to be performed.

Utility Protection: Utility lines and structures indicated on the Drawings, which are to remain in service, shall be protected from any damage. Where utility lines or structures not shown on the Drawings are encountered, Contractor shall report them to the city and the Engineer before proceeding with the Work.

All utilities within 10 feet of the drill pilot bore, back ream or utility carrier pipe installation will be exposed through a soft-dig "pot-hole" or other opening, in accordance with appropriate utility locate laws and regulations, to ensure, through visual inspection, that the drill, reamer or utility carrier pipe has caused no damage to the utility and maintains adequate clearance. All potholes to locate existing utilities shall be sealed with an excavatable grout to avoid a possible flow path for the HDD drilling mud.

Prior to commencing drilling operations, positively locate and stake all existing utility pipelines, cables, storm sewers, or other underground facilities which are located within 10 feet of the designed drilled path.

All work covered by these Technical Specifications shall be performed in accordance with the applicable local, state and federal codes and laws which pertain to such work and supplemental regulations which are contained in these Technical Specifications.

At all times when construction is not in progress, watertight plugs shall be installed in all pipe ends and openings, either following aboveground pipe fusing and storage before pipe pulling or following underground installation after pipe pull back.

503-2.5.2. SUBMITTALS

The Contractor shall prepare a detailed schedule for the work and submit it to the Engineer and the city for approval. The schedule shall include all major tasks to be performed, including but not limited to the following: pipe delivery; rig mobilization and setup; pipe assembly; pilot hole drilling; reaming; pressure testing the pipe before installation; pipe pulling; pressure testing and pigging/flushing the pipe after installation; disinfection of potable water pipelines; anticipated work hours for each task, daily work hours and dates anticipated for each task.

At least 10 days prior to mobilization of equipment, the Contractor shall submit a detailed installation plan to the city and the Engineer for review and approval. The plan shall also include a detailed Plan and Profile of the bore plotted at a scale no smaller than 1-inch equals 20 feet horizontally and 1-inch equals 4 feet vertically. The Contractor shall include a site plan of the entrance and exit pits, the pipe lay down area and equipment staging. Traffic control plans for entry pit, exit pit, and pipe lay down area if different than what is indicated on the Roadway Traffic Control Plan Drawings.

Submit pipe, fittings, specials, joint restraint systems, adapters and couplings shop drawings including complete dimensions including length, internal diameter, pressure rating and wall thickness; maximum allowable deflection of the pipe; detailing; mechanical connections; and necessary accessories for manufacture, transportation, storage, handling, and installation.

Submit pipe assembly procedures including:

1. Descriptions of procedures means and methods for storing, fabricating, handling, transporting, and protecting pipe segments.
2. Calculations of stresses and longitudinal strains developed in pipe during handling and installation.
3. Description of controls to safeguard that the allowable pulling forces will not be exceeded during the installation.
4. Description of procedures for lifting pipe.
5. Calculations showing allowable lifting configurations so allowable stresses will not be exceeded.
6. Welding procedures for high density polyethylene pipe.

Submit a description of procedures, methods and materials that will be used to repair pipe or pipe joints damaged during installation.

Submit a description of methods and materials that will be used to correct leaks in pipe or pipe joints.

Equipment Submittal: Contractor shall submit manufacturer and specifications of directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project. Submittal shall demonstrate that anticipated pullback forces do not exceed the tensile strength of the HDPE pipe with a minimum factor of safety of 2.0. Include calculations prepared by a Professional Engineer licensed in the State of Florida demonstrating maximum allowable pullback forces for this installation / material combination.

Drilling Plan Submittal: Contractor shall submit a Drilling Plan including: Drilling Operations, Reaming Operations, Estimated Pullback Loads, Drilling Fluids Management, Safety Plan, and a Contingency Plan.

A. Drilling Operations submittal shall include:

1. The number and size of construction crew, hours to be worked, pilot hole drilling procedure, reaming procedure, method of tracking and controlling the drilling head, method of verifying pipe location for as-built drawing and schedule for completing major activities.

2. Provide a 2-inch x 34-inch layout drawing(s), scale 1-inch = 20 feet, indicating location of the entry, exit pits, and fluid storage pits, location of fused pipe before pulling (shall not block access to private property), location and type of fusion equipment, storage of waste fluid, and fluid recycling plan (if used).
 3. Spoil handling, separation and disposal.
 4. Provide a detail of the planned bore path and the method of monitoring and controlling the speed, line, grade, and rate of fluids delivery.
 5. Include the sequence, size and description of each reamer and the capabilities of each through the type of soils anticipated to be encountered in the project area.
 6. The Contractor shall maintain the alignment and minimum radii as detailed on the plan sheets and as specified herein.
 7. The drill plan should include a final swabbing of the bore path prior to pipe pullback.
 8. Contractor shall not proceed with work until Drilling Plan is approved by the Engineer and the city.
- B. Reaming Operations submittal shall include the required bore hole size for pullback of the pipeline. The Reaming Operation Plan shall be submitted for review prior to initiation of construction.
- C. Estimated Pullback Loads submittal shall include:
1. The Contractor shall submit to the Engineer an estimate of the anticipated pullback loads that will be required to install the pipe.
 2. Contractor shall include the calculated buoyant force or buoyant weight of the pipe and proposed method for counterweighting or ballasting the pipe during pullback.
 - a. Calculation shall be based on anticipated density of the drilling fluid(s) to be used.
 - b. Any counterweight or ballast pipe placed inside the pipe shall be free from any dirt, grease, oil, or other contaminants that may prevent proper disinfection.
- D. Drilling Fluids Management submittal shall include:
1. Submit MSDS sheets for drilling fluid additives proposed, demonstrating they are non-hazardous.
 2. Proposed mix design for each specific geological strata or formation anticipated during drilling of the bore path.
 3. Estimate of drilling fluids and quantities to be utilized during each reaming pass.
 4. Delivery volume and pressure for each reaming pass and the proposed method for monitoring.
 5. Details of the drilling fluid/soil slurry solids separation, recycling or disposal plan that will describe the equipment and capacities for separation and recirculation.
 - a. If direct vacuum excavation of the slurry is selected, the disposal site shall be identified, and copies of all required permits shall be presented to the Engineer.
 - b. The Contractor shall submit a written plan that details the estimated quantity of slurry to be vacuum excavated and provide substantiation that there is sufficient equipment to adequately pump or shuttle the slurry to and from the disposal site(s) as required to maintain a near continuous drilling and pipe pull-back.
 6. The Contractor shall submit to the Engineer a contingency plan for a quick response team to address inadvertent fluid discharges to the surface (frac-outs). In the event that a drilling fluid fracture, inadvertent returns or loss of returns occurs during pilot hole drilling operations, Contractor shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a March funnel and then wait another 30 minutes. If mud fractures or returns loss continues, Contractor will cease operations and notify the Engineer and the city.

The Engineer, the city and the Contractor will discuss additional options and the Work will then proceed accordingly. Repair and clean-up of damages associated with frac-outs will be resolved in a timely fashion as directed by the city at the Contractor's expense.

- E. Safety Plan submittal: The Contractor shall be responsible for securing a safe worksite that meets all Federal, State, and Local government codes. A project safety and contingency plan which shall include but shall not be limited to drilling fluid containment and cleanup procedures, equipment and plan for compromised utility installations including electrical and power lines, potable water, reclaimed water, wastewater, storm water and any other subsurface utility.
- F. Contingency Plan submittal: Contractor shall submit contingency plans to address procedures to be employed in the event the following may occur:
 1. Obstruction encountered during drilling or reaming.
 2. Broken drill pipe.
 3. Collapsed or buckled carrier pipe or casing pipe.
 4. HDD fails to advance or fails to respond to steering actions.
 5. Alignment deviation is outside allowable limits.
 6. Installation (pull back) forces reach 75% of the max allowable forces.
 7. Ground settlement/heaving exceed allowable limits set by the Engineer and the city.

Project Records and As-Built Drawings submittals shall include the following:

- A. Fusion joint data and fusion technician data indicating conformance with this Technical Specification and applicable standards. This will include fusion joint warranty information and recommended project specific fusion parameters, including criteria logged and recorded by data logger.
- B. Certified copies of test reports of factory tests for the pipe to be inserted into the bore hole prepared by HDD methods required by the applicable standards and this Technical Special Provision. Report shall include at minimum include following information:
 1. Dimensional Checks
 2. Pipe Burst
 3. Flattening
 4. Extrusion Quality (Acetone Immersion)
- C. Project Records: Maintain a complete set of project records. Maintain a daily activity log during Horizontal Directional Drilling operations. Log shall accurately record entire workday. These documents shall include but not be limited to:
 1. Start and finish time of each section of drill pipe for pilot hole drilling and reaming.
 2. For pilot hole drilling, drill bit location at least every 10 ft. along the drill path. Mark the as-built drawings on a daily basis with drilling progress.
 3. General description of ground condition drilled.
 4. Details and perceived reasons for delays greater than one hour other than normal breaks and shift changes.
 5. Details of any unusual conditions or events.

As-built Drawings: Maintain at the construction site a set of field drawings for recording the pilot hole as-built conditions. Plot as-built conditions on the field drawings, including the location in plan and elevation of the pilot hole.

503-2.5.3. QUALITY ASSURANCE AND COORDINATION OF WORK

HDD Contractor's Experience: Any horizontal directional drilling operations 16'' or larger diameter installation shall be conducted by an experienced HDD Contractor. The HDD Contractor shall have minimum of five years of experience constructing horizontal directional drills for pipelines of the same or larger diameter and the same or greater lengths. A responsible representative of the HDD Contractor and the city must be present at all times during a directional drilling operation. A responsible representative as specified herein is defined as a person experienced in the type of Work being performed and who has authority to represent the Contractor in a routine decision making capacity concerning the manner and method of carrying out the Work.

Qualifications and Experience of Contractor Personnel: The Contractor shall employ skilled, experienced superintendent(s), drill rig operators, and key personnel. A competent and experienced superintendent representing the HDD Contractor, that is thoroughly familiar with the equipment and type work to be performed, must always be in direct charge and control of their operation. In all cases the superintendent shall be continually present at the job site during the actual directional drilling.

The superintendent(s) and drill rig operators shall each have at least three years of successful experience using the HDD process, on at least five (5) projects with similar or greater diameters, pull back length and ground conditions. The superintendent(s), drill rig operator, and key personnel shall demonstrate successful completion of at least five (5) projects where pipe was installed with horizontal directional drilling techniques. The Contractor shall furnish resumes of the superintendent(s), drill rig operator(s) and other key personnel. Personnel experience records should include project names, locations, pull back lengths, ground conditions, pipe materials, project description, city project number, Engineer, and references with names, addresses and telephone numbers. The superintendent, drill rig operator(s) and other key personnel listed in the submittal shall be on-site during all construction related activities required for HDD installation.

A responsible representative of the HDD Contractor and the city shall be present at all times during the directional drilling operation. A responsible representative as specified herein is defined as a person experienced in the type of Work being performed and who has authority to represent the Contractor in a routine decision making capacity concerning the manner and method of carrying out the Work.

The HDD Contractor shall always have a sufficient number of competent workers on the job to ensure the directional bore is made in a timely and satisfactory manner. Adequate personnel for carrying out all phases of the actual drilling operation must be on the job site from the beginning through the completion of the work.

The Contractor shall use certified HDPE pipe welding and fusion operators. The certifications of these individuals shall be made available prior to construction. HDPE pipe welding and fusion operators shall be certified by the pipe manufacturer prior to commencement of pipe welding and fusing operations.

The equipment used in directional boring, also known as horizontal directional drilling, shall be of adequate commercial size and satisfactory working condition for safe operation, and may be subject to approval by the city or at the discretion of the Engineer. Such approval, however, shall not relieve the Contractor of the responsibility for making a satisfactory installation meeting the criteria set forth herein. Only workmen experienced in directional boring operations shall be used in performing the Work.

The Contractor shall provide all structures, safety equipment, and professional services required to provide for the health and safety of the general public and of personnel involved in directional boring work in accordance with the requirements of the regulatory agencies having jurisdiction. The Contractor shall take all measures necessary to protect surrounding public and private property, adjacent buildings, roads, drives, sidewalks, and appurtenances from damage due to directional boring work. Responsibility and payment for correction of such damage shall be the sole responsibility of the Contractor and at no additional cost to the city.

The HDD operation is to be operated in a manner to eliminate the discharge of water, drilling mud, and cuttings to nearby water bodies or to the land areas involved during the construction process. If inadvertent spills to nearby water bodies occur, the Contractor shall immediately provide environmental controls and cleanup to the satisfaction of, and at no additional expense to the city.

Best Management Practices (BMP's) for erosion control within the Contractor's work area shall be implemented and maintained at all times during drilling and back-reaming operations to prevent siltation and turbid discharges in excess of State Water quality Standards pursuant to Rule 62-302, F.A.C. Methods shall include but are not limited to the immediate placement of turbidity containment devices such as turbidity screen, silt containment fence, hay bales, and earthen berms, etc. to contain the drilling mud.

503-2.5.4. HDD PIPE PRODUCTS

The horizontal directional drilling shall only use Certa-Loc PVC or butt-welded

HDPE pipe which meets the requirements specified in *Section 502*. Refer to *Section 502-2.4*. for the HDPE Butt Fusion Process and installation procedures for HDD installations.

503-2.5.5. GENERAL HDD INSTALLATION CONSIDERATION

The Contractor shall furnish all equipment and materials required, including but not limited to the following:

1. Drilling equipment (Drilling rig, drill head, drill pipe, drilling control system, pipe pull heads, pipe rollers).
2. Water pumps, hoses, fittings, storage tanks, vacuum truck(s), filters, hay bales, and silt fences, as required.
3. Drilling fluids containment, collection, cleaning and disposal equipment, and materials.
4. Fuel and lubricants.
5. Bentonite and related mixing equipment.
6. All hydrostatic testing equipment and materials.
7. Side booms, cranes, backhoes, trucks and other equipment and materials necessary to load and unload pipe, and to support and smoothly transition the pipe while being pulled into the reamed hole.

All equipment used in the horizontal directional drilling operation shall have the built-in capacity, stability and necessary safety features required to fully comply with the Technical Specifications and requirements of this section without showing evidence of undue stress or failure, and shall otherwise be in sound operating condition.

Backup equipment, sufficient spares and replacement items shall be required where job site conditions indicate that severe damage to the roadway or a hazardous condition may result in the event of an equipment breakdown and where the condition of the equipment to be used indicates that routine component replacement or repair will likely be necessary during the drilling operation.

If equipment breakdowns or other unforeseen stoppages occur and forward motion of the directional cutting head is halted at any time other than for reasons planned in advance (addition of drill stems, etc.), the bore hole shall remain filled with Bentonite slurry and the slurry shall be recirculated periodically.

If an existing utility is damaged, pavement cutting for inspection may be approved by the roadway authority (state, county or city) and the city representative after consideration of all pertinent facts indicates that such action would offer the most practical solution to the problem for all parties concerned.

Any such authorized pavement opening shall be repaired according to appropriate regulatory agency's specifications and requirements. No cutting of the pavement will be allowed on interstate or other limited access roadways unless approved by FDOT.

The boring tool shall have a steering capability and have an electronic tool detection system. The position of the tool during operation shall be capable of being determined accurately both horizontally and vertically.

503-2.5.6. HDD DRILLING EQUIPMENT AND DRILLING FLUID

General: The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore(s) and pullback of the pipe(s), a drilling fluid mixing and delivery system of sufficient capacity to successfully complete the crossing, a drilling guidance system to accurately guide boring operations, a vacuum truck or mud separation plant of sufficient capacity to handle the drilling fluid volume, and trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working

order for the duration of this project. All required equipment shall be included per the emergency and contingency plan as submitted per these Technical Specifications.

Drilling Rig:

- A. The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull drill pipe while delivering a pressurized fluid mixture to a steerable drill head. The machine shall be anchored to withstand the pulling, pushing and rotating forces required to complete the project.
- B. The drilling rig hydraulic system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks.
- C. The drilling rig shall have a system to monitor and record maximum pull-back forces during pull-back operations.
- D. The drilling rig shall be grounded during drilling and pullback operations. There shall be a system to detect electrical current from the drilling string and an audible alarm that automatically sounds when an electrical current is detected.

Drill Head:

- A. The horizontal directional drilling equipment shall produce a stable fluid filled bore hole with the use of a steerable drill head.
- B. The system shall be able to control the depth and direction of the pipe.
- C. Drill head shall contain all necessary cutters and fluid jets for the operation and shall be of the appropriate design for the soil or rock being drilled.

Drill Pipe: Drill pipe shall be constructed of high quality 4130 seamless tubing, Grade D or better, with threaded box and pins. Tool joints should be hardened to 32-36 RC. Drill pipe shall be capable of drilling the design drill path and of pulling back the HDPE pipe.

Drilling Fluid System:

- A. Drilling Fluid (Mud):
 1. Drilling Fluid shall be a high-quality bentonite drilling fluid or equivalent to ensure hole stabilization, cuttings transport, bit and electronics cooling and hole lubrication to reduce drag on the drill pipe and the product pipe. Oil based drilling fluids or fluids containing additives that can contaminate the soil or ground water shall not be considered acceptable substitutes. Composition of the fluid must comply with all applicable local, state and federal environmental regulations.
 2. Drilling fluid shall be composed of clean potable water and the appropriate additive(s) for the fluid to be used. Water shall be from a clean potable source and shall meet the mixing requirements of the manufacturer. Reclaimed water shall not be considered an acceptable alternative to potable water.
 3. Potable water shall be obtained from a metered city Water Utility construction service connection paid for by the Contractor. The contractor shall follow all city Water Utility Department requirements regarding backflow prevention, service water metering, and cross connection control.
 4. The water and additives shall be mixed thoroughly to assure the absence of any clumps or clods. No hazardous additives may be used.
 5. Drilling fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall(s).
 6. Drilling fluid shall be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions. Disposal of drilling fluids shall be in compliance with environmental regulations, right-of-way and workspace agreements and permit requirements.

7. No additional chemicals or polymer surfactants shall be allowed to be added to the drilling fluid as submitted for this project without written consent of the city and the Engineer.
- B. Drilling Fluid Mixing System:
1. A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid for the project.
 2. The drilling fluid reservoir tank shall be a minimum of 1,000 gallons.
 3. The mixing system shall be able to ensure thorough mixing of the drilling fluid. The drilling fluid reservoir tank shall be sized for adequate storage of the fluid.
 4. The mixing system shall continually agitate the drilling fluid during drilling operations.
- C. Drilling Fluid Delivery and Recovery System:
1. The mud pumping system shall have a minimum variable capacity of 35 to 500 gpm and the capability of delivering the drilling fluid at a constant minimum pressure of 1200 psi.
 2. The delivery system shall have filters or other appropriate in-line equipment to prevent solids from being pumped into the drill pipe.
 3. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and disposed of in a legal manner at approved solid waste landfills. The use of spill containment measures shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid recycling system (if used) to prevent spills into the surrounding environment. Pumps, vacuum truck(s), and/or storage of sufficient size shall be in place to contain excess drilling fluid.
 4. A closed-loop drilling fluid system and a drilling fluid cleaning system should be used to the extent practical, depending upon project size and conditions. Under no circumstances shall drilling fluid that has escaped containment (i.e. inadvertent returns) be reused in the drilling system.

Pipe Pull Heads:

- A. Pipe pull heads shall be utilized that employ a positive through-bolt design assuring a smooth wall against the pipe cross-section at all times.
- B. Pipe pull heads shall be specifically designed for use with high density polyethylene (HDPE) pipe or PVC fusible pipe as appropriate and shall be as recommended by the pipe supplier.

Drilling Control System:

- A. Calibration of the electronic detection and control system shall be verified prior to the start of the bore.
- B. The drilling head shall be remotely steerable by means of an electronic or magnetic detection system. The drilling head location shall be monitored in three dimensions, X, Y and Z:
 1. Distance along the baseline, X.
 2. Offset from the baseline, Y, and.
 3. Depth of bore, Z.
- C. The guidance system shall be capable of tracking at all depths up to 50 feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system shall be accurate and calibrated to the manufacturer 's specifications of the vertical depth of the borehole at sensing position at depths up to 50 feet and accurate to 2-feet horizontally.
- D. Point of rotation of the head shall also be monitored.

Pipe Rollers:

Pipe rollers shall be used for pipe assembly and during final product pull back.

503-2.5.7. PREPARATION AND MOBILIZATION FOR HDD OPERATIONS

Do not commence directional drilling until all required submittals have been approved by the Engineer and the city.

Do not begin drilling until all pipe and special items for drilling have been delivered.

All drilling operations shall be accomplished during daylight hours and shall not begin after the hour pre-established as the latest starting time that will allow completion during daylight hours. Planned nighttime work will generally not be allowed unless stipulated in the special conditions of the city's Agreement. In emergency situations, or where delay would increase the likelihood of a failure, nighttime work may be allowed to complete the drilling operations.

Mobilize all necessary personnel, equipment, and materials to construct an entry area for drilling operations. Provide appropriate supports to maintain safe working conditions; ensure stability of the entry, exit, settlement, and containment pits; minimize loosening, deterioration and disturbance of the surrounding ground.

The drilling site shall contain the horizontal directional drilling rig, drill pipe storage racks, water and slurry pumps, slurry mixing tank, cuttings separation equipment, primary settlement and containment pits, dry storage area for bentonite, crane or lifting equipment, and site office.

The pipe launcher/roller system (or equal) shall be constructed in the specified area. The pipe lay down area shall be as determined in conjunction with the Engineer and the city and shall be used to facilitate the installation of the pipeline.

503-2.5.8. ENVIRONMENTAL REQUIREMENTS

Provide equipment and procedures to maximize the recirculation of drilling mud and to minimize waste. Provide solids control and fluid cleaning equipment of a configuration and capacity that can process surface returns and produce drilling fluid suitable for reuse.

Inadvertent surface returns or "frac-outs" of drilling fluid that is accessible on land must be cleaned up immediately and the surface area washed and returned to original condition. All drilling fluids, spoils and separated material will be disposed of in compliance of state and local environmental regulations. If the amount of surface returns exceeds that which can be contained and collected using small sumps, drilling operations shall be discontinued until surface return volumes can be brought under control. Equipment and materials for cleanup and contingencies must be provided and stored at all HDD sites.

Construction related activities involving fuels and lubricants such as vehicle refueling and equipment maintenance, including the draining and pumping of lubricants shall be conducted at a minimum distance of 50 feet from surface water bodies, drainage ditches or swales, drainage pathways and storm water collection structures to eliminate contamination in case of a spill. Any fuels, drilling fluids, or lubricants spilled shall be cleaned up immediately and comply with all FDEP requirements.

Contractor shall provide sanitation and garbage facilities on both sides of the HDD operation. Wastes shall be transported offsite for disposal.

Immediately upon completion of work, all rubbish and debris shall be removed from the job site. All construction equipment and implements of service shall be removed and the entire area involved shall be left in a neat, clean, and acceptable condition approved by the city.

503-2.5.9. DRILLING OPERATIONS

Supply all necessary drilling equipment for completing the HDD installation as shown on the approved Shop Drawings.

The plan and profile for the horizontal directional drilling operation shall be in accordance with the approved Shop Drawings.

Drill entrance and exit angles shall be as shown on the approved Shop Drawings.

Drilling Tolerances: A smoothly curved pilot hole shall follow the designated centerline of the pipe profiles as shown on the Drawings. The directional tolerance of the holes will be as follows:

- A. Deviations from, and corrections to, the design centerline of the HDD pipeline construction shall not exceed 2 percent in depth per 100 feet horizontal or a lesser rate determined by the structural characteristics of the selected pipe and jointing system.
- B. The as-built variance from the designed bore path shall not exceed plus or minus 1-foot in the vertical plane and plus or minus 2-feet in the horizontal plane.

503-2.5.10. HDD INSTALLATION

General: The Contractor shall install the HDPE pipe by the horizontally drilled, directionally controlled method of construction.

Instrumentation: The Contractor shall always provide and maintain instrumentation which shall accurately locate the pilot hole position in the X, Y and Z axes relative to the ground surface and measure drill string axial and torsional loads. Drilling fluid flow rate and pressure shall also be monitored. The Contractor shall maintain and provide to the city Inspector and the Engineer access to the data generated by the downhole survey tools.

Drilling Guidance and Pullback:

- A. Pipe installed by horizontal directional drilling shall be located as shown on the Drawings. The Contractor shall plot the actual horizontal and vertical alignment and the depth of the pilot bore at intervals not exceeding 10 feet. Deviations between the recorded position of the drill string and the specified position of the drill string shall be documented and immediately brought to the attention of the Engineer. This “as-built” plan and profile shall be updated as the pilot bore is advanced. At the completion of the pilot hole, the Contractor shall provide the coordinates of the pilot hole as specified.
- B. The Contractor shall provide and use on land, a separate steering system employing a ground survey grid system, equal to “Tru-Tracker”.
- C. The Contractor shall have accurate working gauges which register tensile force being used to pull the pipeline back through the reamed borehole. If, during the pipeline pulling process, this force reaches 75 percent of the allowable load for the pipeline, the Engineer shall be notified immediately, and the Contractor shall prepare to initiate the contingency plan provided within the approved Project submittals. Logs shall be kept referencing all forces exerted on the pipeline during the installation.
- D. The Contractor shall provide adequate pipe supports/rollers along the stringing area (for both entry and exit pits) to support the required length of pipe for each location. The rollers shall be comprised of a non-abrasive material arranged in a manner to provide support to the bottom and bottom quarter points of the pipeline allowing for free movement of the pipeline during pullback.
- E. The pipe entry area shall be graded to provide support for the pipe to allow free movement into the borehole. The pipe shall be guided in the borehole to avoid deformation of, or damage to the pipe. The pipe shall be installed in a manner which will not cause upheaval, settlement, cracking, movement, or distortion of surface features.
- F. During pullback operations, the Contractor shall monitor roller operation and use side booms if required to assist movement of the pipe and to avoid damage to the pipe.
- G. Cease installation operations if damage to the pipe occurs. Damage to the pipe shall be repaired immediately. Pulling operations shall not resume until the pipe has been repaired.

- H. Pipe pullback shall be planned to occur continuously until complete, except for stoppages planned in the course of the operation such as drill rod removal or if damage to the pipe is observed during pullback that needs to be repaired before continuing. Contractor shall implement necessary buoyancy control as stated in the approved HDD Method and Work Plan.

Location Detection Wire for HDD Pipeline Installations: Refer to *Section 502-2.5.2. B.* for specifications regarding material and installation of Location Detection Wires for HDD installations.

503-2.5.11. DRILLING MUD AND CUTTINGS

The horizontal directional drilling operation shall be conducted in a manner to eliminate the discharge of water, drilling mud, and cuttings to areas not involved in the construction process. The Contractor shall immediately contain and clean-up any inadvertent drilling fluid returns. The Contractor shall also provide equipment and procedures to maximize the recirculation or reuse of drilling mud to minimize waste disposal.

Disposal of water, drilling fluids, drilling mud, cuttings, and muck shall be the Contractor's responsibility. Disposal of waste materials shall be in a legal manner at approved solid waste landfills.

503-2.5.12. REAMING AND PULLBACK

Reaming: Reaming operations shall be conducted at the discretion of the Contractor. Choosing to simultaneously ream and pull back the pipe is at the discretion and the sole risk of the Contractor. All provisions herein relating to simultaneous reaming and pulling back operations shall also pertain to reaming operations.

- A. Prior to pulling pipe, enlarge pilot hole to the diameter identified in the reaming procedure submittal. The Contractor shall ream the borehole to a minimum of 12-inches larger than the outside diameter of the pipe or 1.5 times the outside diameter of the pipe, whichever is less, using the appropriate tools. Complete a swab pass if necessary.
- B. Ream at rates consistent with the drilling equipment and mud system selected.
- C. Continue to monitor the drilling fluid viscosity and density to reduce the potential for frac-out.

Pulling Loads: The Contractor shall be responsible for determining safe pulling loads required for proper installation. Such loads shall be minimized to prevent failure of the pipeline during installation. Once pullback operations have commenced, operations shall continue without interruption until the pipe is completely pulled into the borehole. During pullback operations, the Contractor shall not apply more than the maximum safe pipe pull pressure at any time. A break away head rated at the maximum safe pull pressure shall be utilized.

Torsional Stress: A properly sized and fully operational swivel shall be installed between the reaming assembly at the end of the drilling pipe and the pipeline to restrict torsional stress from being transmitted to the pipeline.

Ballast: The pipeline must be filled with water (ballasting) as installation proceeds, to prevent buckling and reduce buoyancy.

Pull Section Support: The pipe section shall be supported as it proceeds during pull back so that it moves freely.

503-2.5.13. PIPELINE PROTECTION

Protect the interior of the pipe from entry of foreign matter until the installation is complete and accepted.

Contractor shall video record the inside of the pipe after it has been installed and verify that no cracks, breaches, gouges, holes, etc. have occurred during pullback that would decrease the integrity of the pipe.

503-2.5.14. PIPELINE CLEANING

Following installation of the pipeline installed by HDD, the pipeline shall be hydraulically cleaned and flushed as specified in *Section 504* of these Technical Specifications.

503-2.5.15. PIPELINE TESTING

Pressure Testing: Hydrostatically test pipe before and after installation in accordance with *ASTM F2164-Field Leak Testing of Polyethylene Pressure Piping Using Hydrostatic Pressure* and *Section 505*. of these Technical Specifications.

- A. **Test Duration:** The total test time including initial pressurization, initial expansion, and time at test pressure, must not exceed a total of 8 hours. If the test is not completed due to leakage, equipment failure, etc., the test section shall be depressurized and allowed to “relax” for a minimum of 8 hours before it is brought back up to test pressure. The test procedure consists of initial expansion phase and leakage test phase.
- B. **Initial Expansion Phase:** During the initial expansion phase, the test section is pressured to the test pressure and enough make-up water is added each hour for a total of three hours to return to test pressure.
- C. **Leakage Test Phase:** The leakage test phase immediately follows the initial expansion phase. The test section shall be brought back up to the test pressure and remain at that pressure for 4-hours in duration. At the end of the 4-hour test time period, the test section shall be within +/-2 psig of the test pressure with zero leakage (no water added).
- D. **Zero Leakage:** The portion of the HDD pipeline to be hydrostatically tested with HDPE butt fused joints shall have zero leakage for the entire 4-hour leakage test duration for the HDD pipe section to have passed the leakage test.

Test Pressure: The test pressure for the HDD pipeline shall be 150 psi for potable water and reclaimed water or 100 psi for wastewater.

The Contractor shall furnish all materials, equipment, and labor required for making pressure and leakage tests. Tests shall be performed in the presence of the Engineer and the city Inspector.

503-2.5.16. DISINFECTION FOR HDD POTABLE WATER PIPELINES

Final disinfection for potable water pipelines installed by HDD, following cleaning, flushing and pipeline testing, shall be in accordance with *Section 506*. of these Technical Specifications.

503-2.5.17. CITY ACCEPTANCE

If the finished installation of the HDD is not satisfactory to the city, the Engineer or other jurisdictional entity, due to any of the following: the pipe alignment being outside of the specified limits of ± 1.0 foot of the coordinates for the entry or exit points stated on the Drawings; failure to pass the leakage or pressure tests; or internal damage to the pipeline; the pipeline shall be abandoned, fully pressure grouted in place, in accordance with the jurisdictional authority, and an alternate installation shall be constructed. The abandoned pipeline shall be properly shown on Record Drawings to be submitted following conclusion of the construction work.

If the HDD pipeline construction is to provide an HDPE casing pipe for a carrier utility pipe, casing spacers shall not be permitted inside the HDPE casing pipe.

If the HDD installation is for a casing pipe, the Contractor shall end-seal the annular space between the casing pipe and the carrier pipe using concrete brick and mortar which shall extend at least 8-inches into the casing pipe. To secure the ends of the casing and to preclude the entrance of water and soil into the casing, the casing ends shall be completely sealed to be watertight with a neoprene rubber seal specifically manufactured for that purpose. The neoprene end seal shall be attached to the casing and the carrier pipe

with Type 304 stainless steel bands. The casing end seals shall be constructed to be basically watertight to preclude the intrusion of groundwater into the casing. Casing end seals shall be equal to Cascade Water Works Model CCES or an approved equal listed in the *City of Clearwater Approved Products List*.

The Engineer shall inspect the installed pipe ends for roundness and/or damage. Evidence of significant surface scratching shall be brought to the attention of the Engineer. Gouges or excessive surface damage of more than 10 percent of the wall thickness will be grounds to abandon the bore and have the Contractor re-drill another pipeline at no cost to the city.

The city shall be provided with test logs from the Contractor indicating the actual maximum pull loads, maximum deflection angle encountered during the pulling operation and the actual X, Y and Z coordinates of the pipe centerline at a maximum of every 10 feet horizontally of the HDD pipe for review as part of final acceptance.

Contractor shall review the internal video of the HDD installation and report any deficiencies to the Engineer and the city. A copy of the video shall be provided to the city as part of the Record Documents submittal for the completed and accepted Work.

503-2.5.18. REPAIR

Pipes damaged during handling or installation shall be pushed or pulled out or repaired in-place using replacement sections and butt fusion welds recommended by the pipe manufacturer following methods described in the approved submittal.

503-2.5.19. CLEANUP AND REPAIR

Following the installation, remove all equipment, material, drilling mud and waste from both work area ends of the HDD installation. The project site shall be returned to a condition equal to or better than the pre-construction condition of the site. All excavations will be backfilled and compacted to 98% maximum dry density under roadways and hardscape, or to 95% maximum dry density for all other areas and shall be graded to original contours. Compaction Testing shall be performed in accordance with *Section 201-2.9 – Backfill and Compaction* of these Technical Specifications. All pavement and hardscape shall be repaired per applicable jurisdictional standards, excess materials shall be removed from the site, and disturbed areas shall be re-landscaped. All drilling fluid shall be properly disposed of per these Technical Specifications and all applicable jurisdictional laws.

Areas or facilities disturbed or damaged during construction shall be restored to original or better condition with new materials prior to the completion of construction unless specifically identified on the Drawings to be modified. This includes areas or facilities outside or inside the roadway rights-of-way, previous construction activities being done as part of this Project, and ancillary roadways, retention ponds, landscaping, signage, billboards, utility boxes and equipment, utility poles, and utility lines.

503-3. SETTING OF VALVES, HYDRANTS AND FITTINGS

503-3.1. GENERAL

Valves, hydrants, fittings, plugs and caps shall be set and joined to pipe in the manner specified above for installation of pipe.

503-3.2. Fittings

The weight of ductile iron fittings shall not be carried by the pipe on which they are installed. The fitting shall be supported by a concrete cradle as shown on the standard details. Concrete used for supports shall

have a minimum compressive strength of 3,500 psi at 28 days. Concrete for the support cradle shall be poured against undisturbed soil.

All glands, clamps, bolts, nuts, studs, and other uncoated parts of fitting joints for underground installation shall be coated with two coats, 10 mils DFT per coat, of coal tar epoxy equal to Carboline Bitumastic No. 300-M.

503-3.3. VALVES

Valves for potable water mains and reclaimed water mains shall be located within the street rights-of-way lines unless shown otherwise on the plans. All valves shall be installed adjacent to the tee in all cases, not to exceed 18-inches from the main line.

Valves of the size and type shown on the Drawings shall be set plumb and installed at the locations indicated on the Drawings. Valves shall be installed in accordance with the manufacturer's written installation and operation instructions; with the approved shop drawing submittals; and with the details shown on the Drawings.

Buried valves shall be installed such that they are supported properly in their respective positions, free from distortion and strain with a concrete cradle as shown on the Standard Details. Concrete used for supports shall have a minimum compressive strength of 3,500 psi at 28 days. Concrete for the support cradle shall be poured against undisturbed soil. Valves shall be installed such that their weight is not borne by piping or equipment that are not designed to support the weight of the valve. Exposed aboveground valves shall be supported with fabricated piping supports so that the weight of the valve is not carried by the pipeline.

Install gate valves with the operating stem in the vertical position. Valves shall be carefully inspected during installation; they shall be opened wide and then tightly closed and the various nuts and bolts shall be tested for tightness. Special care shall be taken to prevent any foreign material from becoming lodged in the valve seat. Check and adjust all valves for smooth operation.

Aboveground Valves: For aboveground flanged valves, clean iron flanges by wire brushing before installing the valves. Clean stainless-steel flange bolts and nuts lubricate threads with a fluoropolymer coating to prevent galling and tighten nuts uniformly and progressively. Flanged joints shall be watertight; no leaks shall be allowed.

Buried Valves: For buried valves, a valve box shall be centered accurately over the operating nut and the entire assembly shall be plumb. Extensions or risers for valve boxes shall be an integral part of the box. No cut sections of ductile iron or PVC pipe shall be used to extend the valve box to its proper height. The tops of valve boxes shall be adjusted to the proper elevation as specified below and as shown on the Drawings. Care shall be taken while constructing valve boxes to ensure that valve stems are vertical and the cast iron valve box has been placed centered and plumb over the valve stem nut of the valve with base bearing on compacted fill and the top flush or above final grade, as specified below. Valve boxes shall have sufficient bracing to maintain alignment during backfilling. When installation is complete, no pressure shall be exerted by the valve box on either the valve or the pipe. The Contractor shall remove any sand or undesirable trash or debris from valve box interior prior to final inspection.

- A. In paved areas, tops of valve box covers shall be set 1/4-inch below pavement. Following paving operations, a 24-inch square shall be neatly cut in the pavement around the box and the paving removed. The top of the box shall then be adjusted to the proper elevation and a 24-inch square by 6-inch thick concrete pad poured around the box cover. Concrete pads in traffic areas shall be reinforced with No. 4 reinforcement bars as shown on the Drawings. Concrete for the pad shall be 3,500 psi compressive strength at 28 days.
- B. In unpaved areas, tops of valve box covers shall be set 2 inches above finished grade. After the top of the box is set to the proper elevation, a 24-inch square by 6-inch thick concrete pad shall be

poured around the box cover. Concrete for the pad shall be 3,500 psi compressive strength at 28 days.

- C. The concrete pad for the valve box cover shall have a 3-inch diameter, brass identification disc embedded in the concrete surface as shown on the Drawings. The brass identification disc shall have the information as shown on the Drawings neatly engraved, not stamped, on it.

Refer to City Standard Detail Index No. 402; Sheet 1 of 3 & Sheet 2 of 3 for potable water valve pad detail, and City Standard Detail Index No. 502; Sheet 1 of 3 & Sheet 2 of 3 for reclaimed water valve box and pad detail.

Hydrostatic Testing: Valves shall be tested hydrostatically, concurrently with the pipeline in which they are installed. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the pressure used for the pressure test(s). If valve joints leak during pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and hydrostatically retest the joints.

Coating Repair: Following installation of buried valves, repair any scratches, marks and other types of surface damage, etc., with a coating equal to the original coating supplied by the manufacturer. Prior to backfilling, all nuts, bolts, and other parts of the valve joints shall be coated with two coats, 10 mils DFT per coat, of coal tar epoxy equal to Carboline Bitumastic No. 300-M.

503-3.4. FIRE HYDRANTS

Hydrants shall be located as shown or as directed so as to provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians.

Each hydrant shall be connected to the potable water main with a 6-inch ductile iron branch tee with flow controlled by an independent 6-inch mechanical joint gate valve for isolation at the branch of the water main tee. If the fire hydrant is placed greater than 20-feet from the main, an additional 6-inch mechanical joint valve shall be installed at the hydrant location and shall be included in the hydrant assembly cost. The fire hydrant valve cannot be located anywhere within the hydrant ductile iron pipe branch line to circumvent the requirement of using two valves. Refer to *City Standard Detail Index 409*, for potable water hydrants.

All fire hydrants shall stand plumb and shall have their nozzles parallel with, or at right angles to, the curb, with the pumper nozzle facing the curb. Fire hydrants shall be set to the established grade, with nozzles as shown or as directed by the Engineer.

Hydrostatic Testing: Fire hydrants shall be tested hydrostatically, concurrently with the pipeline in which they are installed. If the hydrant mechanical joints leak during pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and hydrostatically retest the joints.

Coating Repair: Following installation of buried portions of the hydrants, repair any scratches, marks and other types of surface damage, etc., with a coating equal to the original coating supplied by the manufacturer. Prior to backfilling, all buried nuts, bolts, and other parts of the hydrant mechanical joints shall be coated with two coats, 10 mils DFT per coat, of coal tar epoxy equal to Carboline Bitumastic No. 300-M.

Reclaimed Water System: No hydrants shall be installed on the reclaimed water system unless approved by the city's Engineering Department.

503-3.5. ANCHORAGE

Movement of all plugs, caps, tees, bends, etc., unless otherwise specified shall be prevented by attaching approved mechanical restraining rings or glands and installed per manufacturer's recommendations.

Hydrants shall be held in place with restrained swivel joints. Restraining mechanical joint glands on hydrants may be used where hydrant run out length precludes the use of hydrant connecting swivel joints.

Where special anchorage is required, such anchorage shall be in accordance with details shown on the plans.

503-4. CONNECTIONS TO EXISTING POTABLE WATER OR RECLAIMED WATER LINES

The Contractor shall coordinate making connection of the new mains to mains which are in service at the time of construction with the city. All potable water or reclaimed water main connections, regardless of new or existing pipe size, to existing potable water or reclaimed water mains shall be made by the Contractor only after the connection procedure and his Work scheduling has been reviewed and approved by the Engineer and the city Engineering Department. The Contractor shall submit a written request to the Engineer and the city Engineering Department a minimum of 5 working days prior to scheduling said connections. The request shall outline the following.

- A. Location of points of connection, fittings to be used, and method of flushing and disinfection, if applicable.
- B. Estimated construction time for said connections.

The Engineer and the city Engineering Department shall review the Contractor's submittal within 3 working days after receiving it and inform the Contractor regarding approval or denial of his request. If this request is rejected by the city, the Contractor shall resubmit his request modifying it in a manner acceptable to the city.

Connections to existing potable water or reclaimed water mains shall only be made following completion of new potable water or reclaimed water main cleaning operations and successful completion of pressure and leakage testing and disinfection clearance of the new potable water main.

The Contractor shall not connect to existing facilities unless the Engineer and a representative of the city are present. All connections shall only be made on the agreed upon date and time. If the Contractor does not initiate and complete the connection work in the agreed upon manner, the Contractor shall be required to reschedule the said connection by following the procedure outlined above.

Operation of all existing potable water or reclaimed water system valves shall be the responsibility of the city's personnel only. At no time shall the Contractor operate any existing system valves. System valves shall be defined as any valve which has main pressure against either side of the valve. The Contractor shall notify the city to request that a valve be operated, at least 5 days prior to the time operation is required.

Upon satisfactory completion of all hydrostatic testing of the new potable water or reclaimed water pipeline, and disinfection of the new potable water pipeline, remove restrained joint caps from both ends of the new pipeline, close main line isolation valves on the existing main, cut and drain the existing main and swab all pipe and fittings for the connection to be installed on the new main with 10 percent hypochlorite solution. The connection of the new main to the existing main shall be made as swiftly as possible and any water collected in the ditch shall be pumped out and kept below the level of the pipe bottom. Following connection and make-up of all fittings, the new pipeline shall then be placed into service by the city's operating personnel.

In the event any existing customers will be without potable water while a connection is being made, the Contractor shall notify the city's Inspector 72 hours prior to disconnection. The city Utility Department shall notify the affected customer(s) when the water will be turned off and when the service is estimated to be resumed. In some instances, these connections may have to be made at late night or early morning hours. No user shall be without potable water service for more than three hours, unless approved otherwise by the city.

504. PIPELINE CLEANING

Following installation of the potable water or reclaimed water pipelines, the pipelines shall be cleaned using a combination of hydraulic cleaning using poly-pig swabbing devices and full bore flushing as specified below.

504-1. PIPELINE PIGGING

All pipelines shall be hydraulically cleaned utilizing multiple pass operations with a polypropylene swabbing device, also referred to as “pigging” operations, of the piping system. Between successive operations, the pig diameter shall increase, and the pig material shall stiffen. Poly pigs shall be blown elastomer polyurethane with open cell-type construction having a material density suitable for use within the system to be cleaned. Pipe cleaning poly pigs shall have a parabolic nose, crisscross coated with a resilient peripheral surface that engages the inner cylindrical wall of the pipe to maintain a sliding seal. Pipe cleaning poly pigs shall be able to pass through a reduction of a minimum of sixty-five percent (65%) of the original cross-sectional area of the pipe and shall be bi-directional. Cleaning procedures shall conform to the Poly Pig manufacturer’s recommendations.

The Contractor shall provide pig launching and retrieval points for the pipeline cleaning, as required. The poly pig cleaning operation shall be completed prior to connection of the new potable water main or reclaimed water main to an existing potable water main or reclaimed water main.

Passage of cleaning poly pigs through the system shall be constantly monitored, controlled, and all poly pigs entered into the system shall be individually marked and identified so that the exiting of the poly pigs from the system can be confirmed.

Cleaning of the pipeline system shall be done in conjunction with the initial filling of the system for the hydrostatic testing.

The line to be cleaned shall only be connected to an existing potable water or reclaimed water distribution system at a single connection point. Only the city’s operating personnel shall operate the supply valve from the existing potable water or reclaimed water distribution system.

The Contractor shall locate and open all new in-line valves beyond the point of connection on the pipeline to be cleaned during the swabbing operation.

At the receiving or exit point for the poly pig, the Contractor is responsible for creating a safe environment for collection of debris, water, and the swab. The Contractor shall provide for the protection of surrounding personnel and property and the safe retrieval of the poly pig.

Temporary blowoffs may be required for the purpose of flushing mains. Temporary blowoffs shall be installed as close as possible to the ends of the main being flushed. Blowoffs installed on the main shall be the same diameter as the main. Temporary blowoffs shall be removed and plugged after the main is flushed.

The city Utility Department shall be notified at least 72 hours prior to pigging and flushing mains.

Cleaning and flushing shall be accomplished by propelling the poly pig down the pipeline to the exit point with potable or reclaimed water, depending on the type of main being cleaned. Flushing shall continue until the water is completely clear and poly pig is retrieved.

- A. Re-apply a series of individual poly pigs in varying diameters and/or densities as required, to attain proper cleanliness of pipeline.
- B. Pigging speed shall range between two and five feet per second.

504-2. FINAL PIPELINE FLUSHING

Following the pigging process for cleaning the pipeline, the length of new water main shall be final flushed with a full-bore clean water flush with a flushing velocity of at least 2.5 fps. The time required for the final full bore flush shall be based on the time needed at the required flushing velocity to provide one complete turnover of the quantity of water in the pipeline based on the length and diameter of water main being flushed.

Blowoffs and temporary drainage piping used for flushing shall not be discharged into any gravity sewer or pumping station wet well. The Contractor shall obtain prior approvals from the Engineer and the city as to the methods and locations of flushing water discharge.

At the discretion of the city, full bore water flushing may not be required for a particular water main based on the size of the main being cleaned and the quantity of water usage required for a full bore water flush.

Following the pigging and flushing process, pressure testing of the pipeline shall be completed in accordance with *Section 505* below.

505. TESTS

505-1. HYDROSTATIC PIPELINE TESTING

General: The Contractor shall perform hydrostatic pressure and leakage tests on all newly laid pressure pipes, fittings and valves for potable water mains and reclaimed water mains. After installation of the water mains, complete with all associated appurtenances including service taps, all sections of newly laid water main shall be subject to a hydrostatic pressure test as described below.

Standard: AWWA C600, Section 4, with the exceptions required herein. The Contractor shall furnish all closure pieces in the pipe as required. All equipment required for the hydrostatic pressure test shall be furnished by the Contractor and shall include, but not be limited to, graduated containers, pressure gauges, meters, testing taps and valves, hydraulic pressure pumps, suitable hoses and piping and any other equipment needed to hydrostatically test the pipelines. Hydrostatic tests shall be conducted on all newly laid potable water main or reclaimed water main pipes, fittings, and valves including any branch lines to the curb. Tests shall be made between valves not exceeding 2,000 feet.

The Contractor may conduct a preliminary hydrostatic test after the trench has been partially backfilled with the joints left exposed for an initial leakage test for his inspection and informational purposes only. The hydrostatic testing for acceptance shall only be conducted after the trenches have been completely backfilled and compacted as specified.

Test new pipelines which are to be connected to existing pipelines by isolating the new line from the existing line by means of pipe caps, special flanges, or blind flanges. After the new line has been successfully tested, remove temporary caps or blind flanges and connect to the existing piping.

The Engineer and the city's Inspector shall be present during all inspection, pressure, and leakage testing for the results to be considered acceptable for the city's acceptance of the new potable water main or reclaimed water main system. Successful passage of both the pressure test and the leakage test is required before acceptance by the city.

The hydrostatic pressure and leakage testing described herein is intended for non-butt-welded jointed pipe with gasketed joints.

Where any section of the piping contains concrete thrust collars, do not proceed with the pressure test until at least 10 days after the concrete has been poured. If high-early cement is used for the concrete thrust collars, the time may be reduced to three (3) days, if the Engineer and the city Engineering Department

both concur that the concrete has cured and reached adequate strength. When testing cement mortar-lined piping, fill the pipe to be tested with water and allow it to soak for at least 48 hours to absorb water before conducting the pressure test.

Each section of pipe to be tested shall be slowly filled with water and the specified test pressure shall be applied by means of a pressure pump connected to the pipe in a satisfactory manner. Before applying the specified test pressure, all air shall be expelled from the pipe as described below. If defective pipes, fittings or valves are discovered in consequence of this pressure test, all such items shall be removed and replaced by the Contractor with sound new material, the pipe shall be re-cleaned and the pressure test shall be repeated until satisfactory results are obtained. Provisions of AWWA C-600, where applicable, shall apply.

Hydrostatic Pressure Test:

- A. **Test Pressure:** Potable Water Mains - 150 psi; Reclaimed Water Mains – 150 psi; Wastewater Force Mains – 150 psi. Apply and maintain the test pressure by means of a hydraulic pressure pump. The test pressure shall be maintained ± 2 psig throughout the entire test period.
- B. **Test Duration:** 2-hours. If during the test, the integrity of the tested line is in question, the Engineer or the city's Inspector may require an additional pressure test.
- C. **Air Release Requirements:** Tapping saddles and corporation cocks at least 3/4-inch in diameter, pipe riser and angle globe valves shall be installed by the Contractor at each dead-end and at all high points in the main to bleed all air from the water main to be tested.
- D. Zero leakage and no pressure loss shall be allowed for the pressure pipe being tested.

Visible Leakage: All visible leaks evident at the ground surface shall be repaired and leakage eliminated.

Leakage Repair: Repairs to leaks shall be completed in strict accordance with the pipe manufacturer's written recommendations. Repair and retest any pipes showing leakage.

Damage or Defects: Any exposed pipe, fittings, valves, hydrants, and joints shall be examined during the test. Any damage or defects that are discovered shall be replaced with new material at no additional cost to the city. The test shall be repeated until no damage or defects are discovered.

505-2. NOTICE OF TEST

The Contractor shall give the city's Project Manager and/or Representative forty-eight (48) hours advance notice of the time when the installation is ready for hydrostatic testing.

City inspector/CEI shall certify and submit all hydrostatic pressure and leakage testing results to the city Project Manager within 10 days of performing test(s).

506. DISINFECTION AND TESTING

Before the new potable water system is put into operation, all new potable water mains and appurtenances and any item of new construction with which the water comes into contact, shall be thoroughly disinfected in accordance with AWWA C651. This section includes materials and procedures for disinfection of water mains by the continuous feed method.

506-1. DISINFECTION MATERIALS

Dry Calcium Hypochlorite: High test granular calcium hypochlorite (HTH) used as the chlorinating agent shall contain between 65 to 70 percent of available chlorine by weight. The dry calcium hypochlorite shall be stored in a cool, dry, and dark environment, prior to its use, to minimize deterioration.

Sodium Hypochlorite Solution: Sodium hypochlorite solution used as the chlorinating agent shall be obtained fresh and shall have a minimum concentration of 10 percent by weight available chlorine. To

minimize degradation, sodium hypochlorite solution shall be stored in opaque, closed polypropylene containers, isolated from contact with any metals and out of direct sunlight. The solution shall be stored in covered (as dark as possible) areas and as cool as possible, prior to use on the jobsite. Sodium hypochlorite solution is highly corrosive. Therefore, the Contractor shall use this chlorinating agent with caution and per the recommendations of the sodium hypochlorite solution manufacturer.

Chlorine Residual Test Kit: To measure chlorine concentration, provide and use a mid-range total chlorine test kit with a digital titrator, using sodium thiosulfate as the titrant. Maintain fresh reagents for the test kit and maintain all components of the kit in good working order available for immediate testing of chlorine residuals at the point of sampling.

506-2. FLUSHING SYSTEM

Prior to pressure testing and application of the disinfection agent for disinfection, all pipelines shall be hydraulically cleaned utilizing multiple pass operations with a polypropylene swabbing device, also referred to as “pigging” operations, of the piping system, followed by full bore flushing. Flushing shall continue until a clean, clear stream of water flows from the hydrants. Where hydrants are not available for flushing, such flushing shall be accomplished at the installed blow off devices generally at the ends of the lines. Cleaning and flushing prior to pressure testing and disinfection shall be in accordance with *Section 504* of these Technical Specifications.

506-3. FINAL DISINFECTION PROCEDURE FOR POTABLE WATER MAINS

Before any portion of a new potable water piping system is to be placed into service, it shall be disinfected; and proper disinfection shall be demonstrated by bacteriological testing conducted in accordance with "Standard Methods for Examination of Water and Sewage" for the coli-aerogenes group, by a commercial laboratory approved by the FDEP, and acceptable to the Engineer and the city, or may be completed by the Pinellas County Health Department.

All pipe, fittings, valves, and all other appurtenances installed for use in potable water pipelines shall be disinfected prior to being placed in service. Disinfection procedures shall be approved by the Engineer and the city and shall be in conformance with ANSI/AWWA C651, latest revision. Contractor shall comply with all General Notes on the Drawings and special requirements that are included with the FDEP permit related to disinfection and clearance of new potable water mains.

Pipe subjected to contaminating materials shall be treated in a manner approved by the Engineer and the city. Should such treatment fail to remove contaminants from the pipe, contaminated sections of pipe shall be replaced with new uncontaminated pipe.

Only potable water from an existing city water main shall be used for disinfection and final flushing of new potable water pipelines. The potable water shall be obtained as described below in *Section 508* of these Technical Specifications.

Disinfection Procedure: Disinfection of a completed potable water pipeline shall be accomplished using the following procedure:

- A. All water piping, fittings, valves, and appurtenances shall be disinfected with a chlorine solution with a sufficient concentration such that the initial chlorine concentration in the water line shall be a minimum of 75 mg/l available chlorine, at any point in the line, and that a chlorine residual of not less than 30 mg/l remains in the water, at any point in the line, after standing 24 hours in the pipeline. The contact period may be longer than 24-hours, if required by the city or the Engineer

before it is flushed out. All valves in the lines being disinfection shall be opened and closed several times during the contact period.

- B. Chlorine may be applied to the water pipeline as a liquid 10% sodium hypochlorite solution, or as a mixture of water and high-test calcium hypochlorite. The Contractor shall assume responsibility for safe handling of chlorinating agents and shall meet requirements of OSHA and other regulatory agencies for safe handling of chlorinating agents.
- C. The dry high-test calcium hypochlorite (HTH) may be used to make up a high concentration chlorine solution which will be used for disinfection. The hypochlorite solution to be used for disinfection should be mixed based on the HTH manufacturer's recommendations. Under no circumstances will undiluted, dry calcium hypochlorite be placed in the pipeline to be disinfected.
- D. The chlorine solution, either 10% sodium hypochlorite or a calcium hypochlorite mixed solution, shall be metered into the pipeline with a small metering pump.
- E. Disinfection of Valves, Blind Flanges and Appurtenances: Swab exposed interior surfaces of valves and blind flanges with a 10% sodium hypochlorite solution prior to installation and bolting in place.
- F. Disinfection of Tapping Sleeves, Tapping Valves and Line Stops: Flush exterior of pipe with potable water after removal of existing coating. Swab exterior of pipe and interior of tapping, sleeve, tapping valve and line stop valve with a 10% sodium hypochlorite solution. Disinfect per AWWA C651, Section 4.8. After completion of tapping and line stopping, swab interior of pipe, valves, and faces of flanges to be connected to bypass piping with a 10% sodium hypochlorite solution.
- G. Disinfection of Connections to Existing Pipelines: Disinfect isolation valves, pipe, and appurtenances per AWWA C651, Section 4.7. Flush with potable water until discolored water, mud, and debris are eliminated. Swab interior of pipe and fittings with a 10% sodium hypochlorite solution. Following disinfection procedures, flush with potable water again until water is free of chlorine odor.
- H. Water from the existing, in-service water line shall be made to flow at a constant, slow rate into the water line to be disinfected. A jumper connection from the existing potable water main to the new water main, utilizing a reduced pressure principle backflow preventer approved by the city, shall be used to obtain water for disinfection. Chlorine solution shall be injected or pumped at a regulated rate into the new main, at a point not more than 10 feet downstream from the beginning of the new water main. The method of tapping the water main for the chlorine injection point and the location of the tap shall be approved by the Engineer and the city.
- I. Proportion the two rates so that the chlorine concentration in the pipeline is maintained at a minimum concentration of 75 mg/L. Check the concentration at points downstream during the filling to ascertain that sufficient chlorine is being added.
- J. Chlorine solution shall be circulated in the water main by opening the water control valve and systematically manipulating valves, fire hydrants and blowoffs.
- K. Water service lines, if applicable, shall be disinfected in a similar manner as that for water mains, including corrective measures, by methods acceptable to the Engineer and the city.
- L. Chlorine solution shall remain in the water lines for not less than 24-hours, but longer than 24-hours, if directed by the Engineer or the city.
- M. Extreme care shall be exercised at all times to prevent concentrated chlorine solution from entering existing water mains.

If methods of disinfection used by the Contractor differ materially from those outlined above, such methods shall be in accordance with directives of the Florida State Board of Health and all methods employed shall have the approval of that agency.

506-4. FLUSHING AND RESIDUAL CHLORINE TESTS

After 24-hours, or when approved by the Engineer and the city, the free residual chlorine concentration in the water line at the pipe extremity sample points shall be checked to make sure the free residual chlorine concentration is at least 30 mg/l; if not, the water lines shall be re-disinfected as described above.

Final flushing of lines with potable water may proceed after 24 hours, or when approved by the Engineer and the city, provided the free residual chlorine analysis is satisfactory at 30 mg/L or above. Flushing shall be continued until a chlorine residual test shows that the pipelines contain only the normal chlorine residual in the feed potable water, not less than 0.2 ppm nor more than 3.0 ppm. Residual chlorine test shall be in accordance with standard methods using a standard DPD test kit. Prior to flushing water with high chlorine concentrations, obtain approvals from the Engineer and the Owner as to the methods and locations of discharge.

City inspector/CEI must certify and submit all residual chlorine test results to the city Project Manager within 10 days of performing test(s).

506-5. BACTERIOLOGICAL TESTS

Following disinfection and thorough flushing of the water lines, as specified herein, the Contractor, and/or the city Public Utilities Department Water Division (or the Engineering Department), shall furnish all labor and materials required to obtain samples of water from the potable water line, at established remote sampling points approved by the FDEP, properly collected in suitable sterilized containers obtained from the Pinellas County Health Department or an analytical laboratory approved by the city and certified by the Florida State Board of Health for bacterial examination in accordance with AWWA C651. Proper techniques and procedures shall be used to collect the water samples to avoid outside contamination resulting in a false positive coliform result. Definite instructions as to the collection and shipment of bacteriological samples shall be secured from the laboratory prior to sample collection and shall be followed in all respects.

Two (2) series of successive samples shall be obtained at each established sampling point in accordance with AWWA C651, Section 5.1, to obtain a bacteriological quality test result to demonstrate the absence of coliform bacteria in each separate section of the pipeline being tested after chlorination, flushing and refilling. Each test series will require two samples at each sampling point. The period between each series of samples shall be a minimum of 24-hours. Samples shall be delivered by the Contractor to the County Health Department or the approved analytical laboratory for bacteriological examination within 6 hours of obtaining the samples. Samples shall be collected in conformance with the County Health Department standards and lab testing schedule. Prior to collecting samples, the Contractor shall notify the Engineer and the city, who will have representatives present during bacteriological sample collection.

Collect at least one set of samples from every 1,000 feet of the new water main and line stopping insertion point, plus one set from the end of the line and at least one set from each branch. At each connection to an existing pipeline, take two additional samples.

Bacteriological test results will be available approximately 48- to 72-hours after samples have been submitted to the testing laboratory. If test results are unsatisfactory, the Contractor shall immediately re-chlorinate and retest the water lines as described above and proceed with such corrective measures as are necessary to secure disinfected lines. All services shall be re-chlorinated if the lines are re-chlorinated. The water lines shall be re-disinfected and re-tested, at the Contractor's expense, until approved by the Engineer, the city, and the Pinellas County Health Department or FDEP, as applicable.

At satisfactory completion of the bacteriological test requirements, potable water pipelines shall be placed into service in a manner approved by the Engineer and the city Engineering Department. Complete the pipeline where temporary disinfection or test facilities were installed. Potable water mains shall not be

placed into service until all requirements of the State and Pinellas County Public Health Departments are met, and the Letter of Clearance is obtained from the Florida Department of Environmental Protection (FDEP). The Contractor shall notify the Engineer and the city at least 72 hours prior to placing potable water pipelines into service.

The city Inspector/CEI shall certify and submit all bacteriological test results to the city Project Manager within 10 days of performing the test(s) as required by the Florida Department of Environmental Protection.

507. CORRECTION OF NON-CONFORMING WORK

All non-conforming work shall be repaired or replaced by the Contractor at no additional expense to the city. Non-conforming work shall be defined as failure to adhere to any specific or implied directive of this Project Manual and/or the drawings, including but not limited to paid not laid straight, true to the lines and grades as shown on the drawings, damaged or unacceptable materials, misalignment or diameter ring deflection in pipe due to bedding or backfilling, visible or detectable leakage and failure to pass any specified test or inspection.

508. OBTAINING WATER FOR FLUSHING AND TESTING

The potable water supply shall be protected with an air gap or a reduced pressure principle backflow preventer approved by the city if potable water is used for flushing and testing. Only potable water shall be used for flushing and pressure testing of potable water pipelines. Reclaimed water may be used for flushing and pressure testing of reclaimed water lines or wastewater force mains.

The city will provide the water required for city Projects. The Contractor shall coordinate with the city for a temporary construction water service connection, intended for usage during flushing and testing.

For private development projects the Contractor will need to obtain temporary potable water service during construction, the Contractor shall be required to pay for the installation and for the water used. The piping, fittings, backflow preventer, and appurtenances required for the temporary construction water service shall be supplied by the city of Clearwater.

509. MEASUREMENT AND PAYMENT

509-1. GENERAL

Bids must include all sections and items as specified herein and as listed on the Bid Form. Payment for the work of constructing the project will be made at the unit price or lump sum payment for the items of work as set forth in the Bid, which payment will constitute full compensation for all labor, equipment, and materials required to complete the work. No separate payment will be made for the following items and the cost of such work shall be included in the applicable pay items of work unless otherwise specified:

- Clearing and grubbing
- Excavation, including necessary pavement removal
- Shoring and/or dewatering
- Structural fill
- Backfill
- Grading
- Tracer wire
- Refill materials
- Joint materials

- Tests and sterilization
- Appurtenant work as required for a complete and operable system.

509-2. FURNISH AND INSTALL WATER MAINS

509-2.1. MEASUREMENT

The quantity for payment shall be the actual number of feet of pipe of each size and type satisfactorily furnished and laid, as measured along the centerline of the completed pipeline, including the length of valves and fittings.

509-2.2. PAYMENT

Payment of the applicable unit price shall be full compensation for furnishing all plant, labor, materials and equipment, and constructing the water mains completely and ready for operation.

509-3. FURNISH AND INSTALL FITTINGS

509-3.1. MEASUREMENT

The quantity for payment will be the actual number of size and type of ductile iron fittings satisfactorily furnished and installed.

509-3.2. PAYMENT

Payment of the applicable unit price shall be full compensation for furnishing all plant, labor, materials, and equipment required to furnish and install ductile iron fittings.

509-4. FURNISH AND INSTALL GATE VALVES COMPLETE WITH BOXES AND COVERS

509-4.1. MEASUREMENT

The quantity for payment shall be the number of gate valves of each size satisfactorily furnished and installed.

509-4.2. PAYMENT

Payment of the applicable unit price for each size shall be full compensation for furnishing all labor, materials, and equipment and installing the gate valve complete with valve box and cover, concrete pad and valve disc, including any jointing materials and any restraint devices required.

509-5. FURNISH AND INSTALL FIRE HYDRANTS

509-5.1. MEASUREMENT

The quantity for payment shall be the number of fire hydrants satisfactorily furnished and installed. The only hydrants allowed to be installed in the city utilities system are listed in *Section 502-5* of these Technical Specifications. No exceptions.

509-5.2. PAYMENT

Payment of the applicable unit price shall be full compensation for furnishing all labor, materials and equipment and installing the fire hydrant assembly complete including all necessary anchor tees, swivel-type thrust anchorage, 6-inch ductile iron pipe between the main and the fire hydrant and gate valve(s) and valve boxes and covers, concrete pad(s) and valve disc(s) on the hydrant branch line and , including any jointing materials and any restraint devices required.

600 SERIES: STORMWATER

601. RAISING OR LOWERING OF STORM DRAINAGE STRUCTURES

Storm Drainage Structures shall be raised or lowered as indicated on the plans or as indicated by the Engineer.

601-1. BASIS OF PAYMENT

Payment, unless covered by a bid item, shall be included in the cost of the work.

602. UNDERDRAINS

The Contractor shall construct sub-surface drainage pipe as directed in the Scope of Work and detail drawings contained in the Project construction plans. In general, underdrain pipe shall be embedded in a bed of #6 FDOT aggregate, located behind the back of curb and aggregate surface covered with a non-degradable fibrous type filter material. A #57 aggregate may be used in lieu of #6 if it is washed and screened to remove fines. The aggregate may be stone, slag, or crushed gravel. Unless otherwise noted on the plans, underdrain pipe shall be eight inches (8") in diameter, polyvinyl chloride pipe, in conformance with ASTM F758 "Standard Specification For Smooth Wall PVC Underdrain Systems for Highways" latest revision, minimum stiffness of 46 in conformance with ASTM D2412, perforations in conformance with AASHTO M-189 described in *FDOT Section 948-1.5* or latest revision and in conformance with ASTM D3034 - SDR 35.

Alternate acceptable underdrain pipe material is Contech A-2000 which is a rigid PVC pipe that exceeds ASTM Specifications D1784, minimum cell classification of 12454B or 12454C, manufactured per ASTM F949-93a, minimum pipe stiffness of 50 psi, with no evidence of splitting, cracking or breaking when pipe is tested in accordance with ASTM D2412 at 60% flattening and with a double gasket joint.

Underdrain pipe placed beneath existing driveways and roadways shall be non-perforated pipe with compacted backfill. All poly-chloride pipe which has become deteriorated due to exposure to ultraviolet radiation shall be rejected. Where ductile iron pipe is specified, pipe material shall be the same as specified for potable water pipe in these technical specifications. All underdrain aggregate shall be fully encased in a polyester filter fabric "sock" (Mirafi® 140-N or approved equal) per the construction detail drawings.

Filter aggregate for underdrains shall be as specified in the *FDOT Standard Specifications, Section 901 – Coarse Aggregate*, and shall be either #6 or #57. If #57 is used, it must be washed and screened to remove fines. The aggregate may be stone, slag, or crushed gravel.

602-1. BASIS OF MEASUREMENT

Measurement shall be the number of linear feet of eight inch (8") Sub-drain in place and accepted.

602-2. BASIS OF PAYMENT

Payment shall be based upon the unit price per linear foot for underdrain as measured above, which shall be full compensation for all work described in this section of the specifications and shall include all materials, equipment, and labor necessary to construct the underdrain (specifically underdrain pipe,

aggregate and filter fabric). Underdrain clean-outs, sod, driveway, road and sidewalk restoration shall be paid by a separate bid item.

603. STORM SEWERS

All storm drainpipe installed within the city shall be steel reinforced concrete unless otherwise approved by the City Engineer. Said pipe shall comply with *Section 430 of FDOT Standard Specifications*.

All reinforced concrete pipe joints shall be wrapped with Mirafi® 140N filter fabric or equivalent (as approved by the City Engineer). The cost for all pipe joint wraps shall be included in the unit price for the pipe.

All pipe, just before being lowered into a trench, is to be inspected and cleaned. If any difficulty is found in fitting the pieces together, this fitting is to be done on the surface of the street before laying the pipe, and the tops plainly marked in the order in which they are to be laid. No pipe is to be trimmed or chipped to fit. Each piece of pipe is to be solidly and evenly bedded, and not simply wedged up. Before finishing each joint, some suitable device is to be used to find that the inverts coincide, and pipe is clear throughout.

603-1. TESTING AND INSPECTION

The Contractor shall take all precautions to secure a watertight sewer under all conditions.

The work under this Section shall include the internal video recording of new stormwater drainage pipes and drainage structures. The Contractor shall provide the city with a video of the completed stormwater drainage system, and a written report. The Contractor shall pump down and clean the pipes and drainage structures, to the satisfaction of the city, prior to video recording. The video shall be of the standard DVD format, in color, with all the pertinent data and observations recorded as audio on the DVD. The data should include:

1. An accurate recorded footage of the pipe lengths.
2. The drainage structure number and pipe size.
3. The run of the pipe and direction of flow (i.e. from S-1 to S-2).
4. Details of structural defects, broken pipes, sags, dips, misalignments, obstructions, and infiltration.

The written report shall include the four (4) items listed previously.

All visual and video recording inspections shall be completed by the Contractor and be in accordance with *Section 430-4.8 of FDOT Standard Specifications*. Any deficient or damaged pipe discovered during the video recording process shall be the responsibility of the Contractor to repair or replace at their own expense within the contractual duration.

As a complement to the video report, the Contractor shall also provide digital photos of areas of concern in electronic (computer CD/DVD) and hard copy form (in color).

All known pipe breaks or those breaks discovered after the video inspection shall be repaired by the Contractor regardless of the test allowances. Faulty sections of drainage pipes or drainage structures rejected by the Engineer shall be removed and re-laid by the Contractor. Sections of pipe that are repaired, re-laid or replaced shall be accompanied with a corresponding post construction video inspection at the Contractor's expense. In all cases that a leak is found, re-inspection shall be required at the Contractor's expense, to confirm that the problem has been resolved.

603-2. BASIS OF PAYMENT

Payment shall be the unit price per linear foot for storm sewer pipe in place and accepted, measured along the centerline of the storm sewer pipe to the inside face of exterior walls of storm manholes or drainage

structures and to the outside face of endwalls. Said unit price includes all work required to install the pipe (i.e. all materials, equipment, filter fabric wrap, gravel bedding if needed for stabilization, labor, and incidentals, etc.).

604. STORM MANHOLES, INLETS, CATCH BASINS OR OTHER STORM STRUCTURES

For details on specific design of a type of storm structure refer to city of *Clearwater Standards Details Index Numbers 201 to 236*.

When required, inlets, catch basins or other structures shall be constructed according to the plans and applicable parts of these Technical Specifications, *Sections 301, 302, 303 and 202*, and as approved by the Engineer. Said structures shall be protected from damage by the elements or other causes until acceptance of the work.

604-1. BUILT UP TYPE STRUCTURES

Built up type manholes shall be constructed of brick with cast iron frames and covers as shown on city of *Clearwater Standard Details Index Numbers 201*. Invert channels shall be constructed smooth and semicircular in shape conforming to inside of adjacent sewer section. Changes in direction of flow shall be made in a smooth curve of as large a radius as possible. Changes in size and grade of channels shall be made gradually and evenly. Invert channels shall be built up with grout.

The storm structure floor outside of channels shall be made smooth and sloped toward channels.

Manhole steps shall not be provided. Joints shall be completely filled, and the mortar shall be smoothed from inside of the manholes.

The entire exterior of brick manholes shall be plastered with a skim coat of one-half inch (1/2") of mortar.

Brick shall be laid radially with every sixth course being a stretcher course.

In cases where a storm pipe extends inside a structure, the excess pipe will be cut off with a concrete saw and shall not be removed with a sledgehammer.

604-2. PRECAST TYPE

Precast manholes shall be constructed as shown on city of *Clearwater Standards Details Index 202*. The manhole base shall be set on a pad of dry native sand approximately five inches (5") thick to secure proper seating and bearing.

Precast Manholes and Junction Boxes: The Contractor may substitute precast manholes and junction boxes in lieu of cast in place units unless otherwise shown on the plans. Precast Inlets will not be acceptable. When precast units are substituted, the construction of such units must be in accordance with ASTM C478, or the standard specifications at the manufacturer's option.

Precast structures must also meet the requirement that on the lateral faces, either inside or outside, the distance between precast openings for pipe or precast opening and top edge of precast structure be no less than wall thickness. A minimum of four courses of brick will be provided under manhole ring so that future adjustment of manhole lid can be accommodated. Manhole steps shall not be provided.

604-3. BASIS OF PAYMENT

Payment for Junction Boxes, Manholes or other structures shall be on a unit basis.

605. GABIONS AND MATTRESSES

605-1. MATERIAL

605-1.1. PVC COATED WIRE MESH GABIONS & MATTRESSES

605-1.1.1. GABION & MATTRESS BASKETS

Gabion and mattress baskets units shall conform to ASTM A975, be of non-raveling construction and fabricated from a double twist by twisting each pair of wires through three half turns developing the appearance of a triple twist. The galvanized wire core shall have a diameter of 0.106 inches.

605-1.1.2. PVC (POLYVINYL CHLORIDE) COATING

The coating shall be gray in color and shall have a nominal thickness of 0.0216 inches but not less than 0.015 inches in thickness. The protective PVC plastic shall be suitable to resist deleterious effects from exposure to light, immersion in salt or polluted water and shall not show any material difference in its initial compound properties. The PVC compound is also resistant to attack from acids and resistant to abrasion.

The PVC coating shall be extruded and adhere to the wire core prior to weaving. The PVC coated wire shall be woven into a double twisted hexagonal mesh having uniform openings of 3 1/4 inches by 4 1/2 inches. The overall diameter of the mesh wire (galvanized wire core plus PVC coating) shall be 0.146 inches. Selvedge and reinforcing wire shall be of heavily galvanized wire core, 0.134 inches in diameter, coated with PVC and having an overall diameter (galvanized wire core plus PVC coating) of 0.174 inches. Lacing and connecting wire shall be of soft tensile strength (75,000 PSI max), heavily galvanized wire core, 0.087 inches in diameter, coated with PVC and having an overall diameter (galvanized wire core plus PVC coating) of 0.127 inches. The use of alternate wire fasteners shall be permitted in lieu of tie wire providing the alternate fastener produces a four (4) wire selvedge joint with a strength of 1200 lbs. per linear foot while remaining in a locked and closed condition. Properly formed interlocking fasteners shall be spaced from 4 to 6 inches and have a minimum 3/4 square inch inside area to properly confine the required selvedge wires.

605-1.1.3. GABION AND MATTRESS FILLER MATERIAL

The filler stone shall be from a source approved by the Engineer before delivery is started. Representative preliminary samples of the stone shall be submitted by the contractor or supplier for examination and testing by the Engineer. The stone shall have a minimum specific gravity of 2.3 and be of a quality and durability sufficient to insure permanency in the structure. The individual stones shall be free of cracks, seams, and other defects that would tend to promote deterioration from natural causes, or which might reduce the stones to sizes that could not be retained in the gabion or mattress baskets.

All filler material shall be uniformly graded between 4 inch and 8 inch (equivalent spherical diameter) and shall be angular in form. Rounded stones shall not exceed 10% of the stone, by weight and 70% of the stone, by weight, shall exceed the largest dimension of the mesh opening. Crushed concrete shall not be used for filler material.

605-1.1.4. GEOTEXTILE FABRIC

Fabric shall conform to the latest edition of *FDOT Standard Specifications, Section 985*.

605-2. PERFORMANCE

Gabions and Reno Mattresses shall be installed according to the manufacturer's recommendations and as shown on the Drawings. Fabrication of gabion baskets shall be in such a manner that the sides, ends, lid and diaphragms can be assembled at the construction site into rectangular baskets of the sizes specified and shown on the Drawings. Gabions and mattresses shall be of single unit construction; the base, lid ends and sides shall be either woven into a single unit or one edge of these members connected to the base section of the gabion in such a manner that the strength and flexibility at the connecting point is at least equal to that of the mesh. Where the length of the gabion and mattress exceeds one and one-half its horizontal width, they shall be equally divided by diaphragms of the same mesh and gauge as the mattresses shall be furnished with the necessary diaphragms secured in proper position on the base so that no additional tying is required at this juncture. The wire mesh is to be fabricated so that it will not ravel. This is defined as the ability to resist pulling apart at any of the twists or connections forming the mesh when a single wire strand in a section of mesh is cut.

Each gabion or mattress shall be assembled by tying all untied edges with binding wire. The binding wire shall be tightly looped around every other mesh opening along seams so that single and double loops are alternated.

A line of empty gabions shall be placed into position according to the contract drawings and binding wire shall be used to securely tie each unit to the adjoining one along the vertical reinforced edges and the top selvages. The base of the empty gabions placed on top of a filled line of gabions shall be tightly wire to the latter at front and back.

To achieve better alignment and finish in retaining walls, gabion stretching is recommended.

Connecting wires shall be inserted during the filling operation in the following manner: Gabions shall be filled to one third full and one connecting wire in each direction shall be tightly tied to opposite faces of each cell at one third height. The gabion shall then be filled to two thirds full and one connecting wire in each direction shall be tightly tied to opposite face of each cell at one two third height. The cell shall then be filled to the top.

Filler stone shall not be dropped more than twelve inches (12") into the gabions and mattresses.

Geotextile fabric shall be installed at locations shown in the Drawings. The surface to receive the cloth shall be prepared to a relatively smooth condition free of obstructions which may tear or cut the cloth. The panel shall be overlapped a minimum of 30 inches and secured against movement. Cloth damaged or displaced during installation, gabion work, or backfill shall be replaced or repaired to the satisfaction of the Engineer at the contractor's expense. The work shall be scheduled so that the fabric is not exposed to ultraviolet light more than the manufacturer's recommendations or five days, whichever is less.

In wet conditions, a base shall be established by spreading and compacting #57 stone prior to placement of geotextile fabric and gabions or mattresses.

700 SERIES: STREETS AND SIDEWALKS

701. RESTORATION OR REPLACEMENT OF DRIVEWAYS, CURBS, SIDEWALKS AND STREET PAVEMENT

Driveways, sidewalks, and curbs destroyed or damaged during construction shall be replaced with the same type of material that was destroyed or damaged, or to existing city Standards, whichever provides the stronger repair. All street pavement destroyed or damaged shall be replaced with the same type of material, to existing city Standards, unless the existing base is unsuitable as determined by the Engineer, then the base shall be replaced with city approved material. All replaced base shall be at least eight inches (8") compacted thickness, or same compacted thickness as the base destroyed plus two inches (2") and compacted to 98% of maximum density per AASHTO T-180. Refer to *Standard Detail Index 104*.

Unless called for in the proposal as separate bid items, cost of the above work including labor, materials and equipment required shall be included in the bid price per linear foot of main or square yard of base.

The bid price for street pavement, restoration or replacement when called for in the proposals, shall include all materials, labor and equipment required to complete the work, and shall be paid for on a square yard basis. When replacement is over a trench for utilities, the area of replacement shall be limited to twice the depth of the cut plus twice the inside diameter of the pipe. All necessary restoration exceeding this footprint will be at the Contractor's expense.

The bid price for restoration or placement of driveways, curbs and sidewalks, when called for in the proposals, shall include all materials, labor and equipment required to complete the work and shall be paid for on the basis of the following units: Driveways, plant mix - per square yard; concrete - per square foot; curbs - per linear foot; sidewalk four inches (4") or six inches (6") thick - per square foot. Concrete walks at drives shall be a minimum of six inches (6") thick and be reinforced with 6/6 X 10/10 welded wire mesh. The Contractor shall notify the Construction Inspector a minimum of twenty-four (24) hours in advance of all driveway, curb, sidewalk and street restoration and replacement work.

702. ROADWAY BASE AND SUBGRADE

702-1. BASE

This specification describes the construction of roadway base and subgrade. The Contractor shall refer to *Section IV, Section 101 "Scope of Work"* of the city's Contract Specifications for additional roadway base and subgrade items.

Roadway base shall be eight inches (8") compacted minimum thickness unless otherwise noted on the plans or directed by the Engineer. The subgrade shall be twelve inches (12") compacted minimum thickness with a minimum Limerock Bearing Ratio (LBR) of 40 unless otherwise noted on the plans or directed by the Engineer. The Contractor shall obtain from an independent testing laboratory a Proctor and an LBR for each type material. The Contractor shall also have an independent testing laboratory perform all required density testing. Where unsuitable material is found within the limits of the base, *Section IV, Section 204 - Unsuitable Material Removal* of the city's Technical Specifications will apply.

Once the roadway base is completed, it shall be primed that same day (unless otherwise directed by the Engineer) per *Section 300 of FDOT's Standard Specifications*. Repairs required to the base that result from a failure to place the prime in a timely manner shall be done to the city's satisfaction, and at the Contractor's expense. No paving of the exposed base can commence until the city approves the repaired base. The cost for placement of prime material shall be included in the bid item for base.

The Contractor shall notify the Project Inspector a minimum of twenty-four (24) hours in advance of all base and subgrade placement or reworking.

The following base materials are acceptable:

1. **Shell Base:** Shell base shall be constructed in accordance with the latest edition of *Sections 200 and 913 of FDOT's Standard Specifications* and shall have a minimum compacted thickness as shown on the plans. The shell shall be FDOT approved. The cost of the prime coat shall be included in the bid item price for base.
2. **Limerock Base:** Limerock base shall be constructed in accordance with *Sections 200 and 911 of FDOT's Standard Specifications* and shall have a minimum compacted thickness as shown on the plans. The limerock shall be from a FDOT approved certified pit. The cost of the prime coat shall be included in the bid item price for base. When used, Contractor is required to submit documentation certifying the materials were obtained from a FDOT certified pit.
3. **Crushed Concrete Base:** Crushed concrete base shall be constructed in accordance with the latest edition of *Sections 204 and 901 of FDOT's Standard Specifications* and shall have a minimum compacted thickness as shown on the plans. The crushed concrete material shall be FDOT approved. The Contractor shall provide certified laboratory tests on gradation to confirm that the crushed concrete base material conforms to the above specifications. The LBR shall be a minimum of 100. LBR and gradation tests shall be provided to the city by the Contractor once a week for continuous operations, or every 1000 tons of material, unless requested more frequently by the City Engineer or designee. The cost of the prime coat shall be included in the bid item price for base.
4. **Superpave Asphalt Base:** Full depth asphalt base shall be constructed in accordance with the latest edition of *Section 234 of FDOT's Standard Specifications* and shall have a minimum compacted thickness as shown on the plans. The cost for preparation, placement, and compaction shall be included in the per ton unit cost for asphalt unless otherwise noted in the project scope and plans. The cost of the tack coat shall be included in the bid item price for asphalt or base.
5. **Reclaimed Asphalt Pavement Base:** Reclaimed asphalt pavement (RAP) base shall be constructed in accordance with the latest edition of *Section 283 of FDOT's Standard Specifications* and shall have a minimum compacted thickness as shown on the plans. As per *FDOT Section 283*, RAP material shall be used as a base course only on non-limited access paved shoulders, shared use paths, or other non-traffic bearing applications. The cost for preparation, placement, and compaction shall be included in the per ton unit cost for asphalt unless otherwise noted in the project scope and plans. The cost of the tack coat shall be included in the bid item price for asphalt or base.

702-1.1. BASIS OF MEASUREMENT FOR BASE AND REWORKED BASE

The basis of measurement shall be the number of cubic yards of base in place and accepted as called for on the plans. The maximum allowable deficiency shall be a half-inch (1/2"). Areas deficient in thickness shall either be fixed by the Contractor to within acceptable tolerance, or if so, approved in writing by the City Engineer, may be left in place. No payment, however, will be made for such deficient areas that are left in place.

702-1.2. BASIS OF PAYMENT FOR BASE AND REWORKED BASE

The unit price for base shall include: all materials, roadbed preparation, placement, spreading, compaction, finishing, prime, base, subgrade (unless the plans specify a separate pay item), stabilization, mixing, testing, equipment, tools, hauling, labor, and all incidentals necessary to complete the work. Payment for asphalt base shall be included in the per ton unit cost for asphalt unless otherwise noted in the project scope and plans.

702-2. SUBGRADE

All subgrade shall be stabilized and constructed in accordance with the latest edition of *Sections 160 and 914 of FDOT's Standard Specifications* unless otherwise noted herein. All subgrade shall have a minimum compacted thickness of 12" unless otherwise shown on the plans or directed by the Engineer. If limerock is used, it shall also meet the requirements of *Section 911 of FDOT's Standard Specifications*. Where unsuitable material is found within the limits of the subgrade, *Section IV, Section 204 - Unsuitable Material Removal* of the city's Contract Specifications will apply. The extent of said removal shall be determined by the Engineer in accordance with accepted construction practices. The Contractor is responsible for clearing, grading, filling, and removing any trees or vegetation in the roadbed below the subgrade to prepare it per the plans. The cost of this work shall be included in the unit price for base or subgrade. The Contractor shall obtain from an independent testing laboratory the bearing value of the subgrade after the materials are mixed for the stabilized subgrade and provide the results to the Engineer.

702-2.1. BASIS OF MEASUREMENT

The basis of measurement shall be the number of cubic yards of stabilized subgrade in place and accepted as called for on the plans. The maximum allowable deficiency for mixing depth shall be per the latest edition of *Section 161-6.4 of FDOT's Standard Specifications*. Acceptable bearing values shall be per the latest edition of *Section 160-7.2 of FDOT's Standard Specifications*. Areas deficient in thickness or bearing values shall either be corrected by the Contractor to within acceptable tolerance, or if so, approved in writing by the City Engineer, may be left in place. No payment, however, will be made for such deficient areas that are left in place.

702-2.2. BASIS OF PAYMENT

The unit price for subgrade shall include roadbed preparation, placement, spreading, compaction, finishing, testing, stabilizing, mixing, materials, hauling, labor, equipment and all incidentals necessary to complete the work. If no pay item is given, subgrade shall be included in the bid item for base.

703. ASPHALTIC CONCRETE MATERIALS

This specification is for the preparation and application of all asphaltic concrete materials on roadway surfaces unless otherwise noted.

703-1. ASPHALTIC CONCRETE

703-1.1. AGGREGATE

All aggregates shall be obtained from an approved FDOT source and shall conform to the latest edition of *Sections 901 through 915 of FDOT's Standard Specifications*.

703-1.2. BITUMINOUS MATERIALS

All bituminous materials shall conform to the latest edition of *Section 916 of FDOT's Standard Specifications*.

703-2. HOT BITUMINOUS MIXTURES – PLANT, METHODS, EQUIPMENT & QUALITY ASSURANCE

The plant and methods of operation used to prepare all asphaltic concrete and bituminous materials shall conform to the requirements of *Section 320 of FDOT's Standard Specifications*. Unless otherwise noted, all acceptance procedures and quality control/assurance procedures shall conform to the requirements of *Section 330 of FDOT's Standard Specifications*.

The city shall have the right to have an independent testing laboratory select, test, and analyze, at the expense of the city, test specimens of any or all materials to be used. The results of such tests and analyses shall be considered, along with the tests or analyses made by the Contractor, to determine compliance with the applicable specifications for the materials so tested or analyzed. The Contractor hereby understands and accepts that wherever any portion of the work is discovered, as a result of such independent testing or investigation by the city, which fails to meet the requirements of the Contract documents, all costs of such independent inspection and investigation as well as all costs of removal, correction, reconstruction, or repair of any such work shall be borne solely by the Contractor.

Payment reductions for asphalt related items shall be determined by the following:

1. Density per FDOT's Standard Specifications.
2. Final surface or friction course tolerances per FDOT's Standard Specifications.
3. Thickness will be determined from core borings. Deficiencies of 1/4" or greater shall be corrected by the Contractor, without compensation, by either replacing the full thickness for a length extending at least twenty-five feet (25') from each end of the deficient area, or when the Engineer allows for an overlay per FDOT's Standard Specifications. In addition, for excesses of one-quarter inch (1/4") or greater, the Engineer will determine if the excess area shall be removed and replaced at no compensation, or if the pavement in question can remain with payment to be made based on the thickness specified in the contract.

The Contractor shall notify the Project Inspector a minimum of twenty-four (24) hours in advance of the placement of all asphalt.

703-3. ASPHALT MIX DESIGNS AND TYPES

All asphalt mix designs, acceptance procedures and quality control/assurance procedures shall conform to the requirements of the latest edition of *Sections 330 and 334 of FDOT Standard Specifications*. All asphalt mix designs shall be approved by the Engineer prior to the commencement of the paving operation. Reclaimed asphalt pavement (RAP) material may be substituted for aggregate in the asphaltic concrete mixes up to 25% by weight.

703-4. ASPHALT PAVEMENT DESIGNS AND LAYER THICKNESS

All asphalt pavement designs shall conform to the following FDOT requirements:

- Type SP/Spec 334-1
- Type FC/Spec 337-8
- Type B/Spec 234-8
- ATPB/287-8

703-5. GENERAL CONSTRUCTION REQUIREMENTS

The general construction requirements for all hot bituminous pavements (including limitations of operations, preparation of mixture, preparation of surface, placement and compaction of mixture, surface

requirements, correction of unacceptable pavement, Quality Control Testing, etc.) shall be in accordance with *Section 330 of FDOT's Standard Specifications*(latest edition).

703-6. CRACKS AND POTHOLE PREPARATION

703-6.1. CRACKS

Cracks in roadway pavement shall be repaired prior to the application of asphaltic concrete by the following steps:

1. All debris to be removed from cracks by compressed air or other suitable method.
2. Apply a multiple layered application of bituminous binder and fine aggregate, as appropriate to the depth of the crack until the void of the crack is completely filled to the level of the surrounding roadway surface.
3. If application of asphaltic concrete is not to begin immediately after crack repair, cracks are to be sanded to prevent vehicular tracking.
4. Payment for crack filling shall be included in the unit price for asphaltic concrete.

703-6.2. POTHoles

Potholes shall be repaired prior to the application of asphaltic concrete by the following steps:

1. All debris is to be removed from potholes by hand, sweeping, or other suitable method.
2. A tack coat is to be applied to the interior surface of the pothole.
3. The pothole is to be completely filled with asphaltic concrete, and thoroughly compacted.
4. Payment for pothole preparation shall be included in the unit price for asphaltic concrete.

703-7. ADJUSTMENT OF MANHOLES AND APPURTANENCES

The necessary adjustments of sanitary sewer and storm drain manholes and appurtenances shall be accomplished by the Contractor. The Contractor shall be paid on a per unit basis for each item. Refer to *Section 401-2* of these Technical Specifications for additional information.

The use of manhole adjustment risers is acceptable under the following conditions:

1. The riser shall meet or exceed all FDOT material, weld, and construction requirements.
2. The riser shall consist of an A-36 hot rolled steel meeting or exceeding the minimum requirements of ASTM A36.
3. The riser shall be a single piece with a stainless-steel adjustment stud and shall have a rust resistant finish.
4. The use of cast iron or fiberglass risers is not permitted.

In addition, the installation of each riser shall be per manufacturer's specifications. Each manhole shall be individually measured, and each riser shall be physically marked to ensure that the proper riser is used. Also, the ring section shall be cleaned, and a bead of chemically resistant epoxy applied to the original casting, prior to installation of the riser. It is the Contractor's responsibility to ensure that the manholes are measured, the risers are physically marked, the ring sections are thoroughly cleaned, and that the epoxy is properly applied prior to installation of each riser.

If risers are not used, the adjustment of manholes shall be accomplished by the removal of pavement around manhole, grade adjustment of ring and cover, and acceptable replacement and compaction of roadway materials prior to paving. A full depth backfills using asphalt is acceptable. The use of Portland cement for backfill is not acceptable.

All manhole and valve box adjustments shall be accomplished prior to the application of final asphaltic concrete surface. Unless otherwise noted in the specs or on the plans, the paving operation shall occur within seven (7) calendar days from the completion of the adjustment. On arterial roadways, the manholes are to be ramped with asphalt during the time period between initial adjustment and final resurfacing. Water and gas valves, sewer cleanouts, valve boxes, tree aeration vents, etc., will be adjusted by the Contractor with the cost for this work to be included in the unit cost of the asphalt. Care must be taken around said appurtenances to ensure that they are not paved over. It is the Contractor's responsibility to inform the owners of all utilities of impending work and coordinate their adjustments, so they are completed prior to the scheduled paving.

703-8. ADDITIONAL ASPHALT REQUIREMENTS

1. All impacted radius returns within project limits shall be paved unless otherwise directed by the Construction Inspector or Engineer, with payment to be included in the per ton bid item for asphalt.
2. All pavement markings impacted by placement of asphalt shall be replaced prior to the road being open to traffic unless otherwise noted in the contract scope and plans.
3. All project related debris shall be hauled off the job site by the Contractor in a timely manner and at their own expense in conformance with all regulatory requirements.
4. The Contractor shall pay particular attention to sweeping when paving. Prior to paving, all construction areas shall be swept with a Municipal type sweeper (either vacuum or mechanical type) that picks up and hauls off, dust and dirt. The sweeper must be equipped with its own water supply for pre-wetting to minimize dust. Moreover, the Contractor shall sweep debris off from sidewalks, driveways, curbs and roadways each day before leaving the job site.
5. The application of tack and prime coats (either required or placed at the Engineer's discretion) shall be placed per *Section 300 of FDOT's Standard Specifications*. Tack shall also be applied to the face of all curbs and driveways. The cost (including heating, hauling, and applying) shall be included in the per ton bid item for asphalt, unless otherwise noted in the project scope and plans.
6. Leveling course and spot patching shall be applied to sections of the road as noted on the plans, or as directed by the Engineer, per *Section 330 of FDOT's Standard Specifications*. The cost shall be included in the per ton unit cost for asphalt, unless otherwise noted in the project scope and plans.
7. If an asphalt rubber binder is required, it shall conform to the requirements of *Section 336 of FDOT's Standard Specifications*.
8. On all streets with curb and gutter, the final compacted asphalt shall be one-quarter inch ($\frac{1}{4}$ ") above the lip or face of said curb per *City Standard Detail Index 101*.

703-9. BASIS OF MEASUREMENT

Basis of measurement will be the number of tons of asphaltic concrete completed, in place and accepted. Truck scale weights will be required for all asphaltic concrete used. The scales must be calibrated and certified by an independent party and carry a state certification.

703-10. BASIS OF PAYMENT

Payment shall be made at the contract unit price for asphaltic concrete surface as specified and measured above. This price shall include all materials, preparation, hauling, placement, tack and/or prime coat either required or placed at Engineer's discretion, leveling, spot patching, filling of cracks, pothole repair, sweeping, debris removal, labor, equipment, tools, and incidentals necessary to complete the asphalt work in accordance with the plans and specifications.

704. ADJUSTMENT TO THE UNIT BID PRICE FOR ASPHALT

When this Section applies to the contract, the unit bid price for asphalt will be adjusted in accordance with the following provisions:

1. Price adjustment for asphalt shall only be made when the current FDOT Asphalt Price Index varies more than ten percent (10%) from the bid price at the time of the bid opening.
2. The Bituminous Material Payment Adjustment Index published monthly by the FDOT shall be used for the adjustment of unit prices. This report is available on FDOT's internet site. The address is: <https://www.fdot.gov/construction/fuel-bit/fuel-bit.shtm> For additional information, call FDOT at (850) 414-4252.
3. The FDOT Payment Adjustment Index in effect at the time of the bid opening will be used for the initial determination of the asphalt price.
4. The FDOT Payment Adjustment Index in effect at the time of placement of the asphalt will be used for payment calculation.
5. The monthly billing period for contract payment will be the same as the monthly period for the FDOT Payment Adjustment Index.
6. No adjustment in bid prices will be made for either tack coat or prime coat.
7. No price adjustment reflecting any further increases in the cost of asphalt will be made for any month after the expiration of the allowable contract time.
8. The city reserves the right to make adjustments for decreases in the cost of asphalt.

705. ASPHALT DRIVEWAYS

New driveways or existing asphalt driveways that must be altered for project construction shall be constructed or replaced in accordance with the specifications for paving the street with the exception that the base shall be six inches (6"). Remove only enough to allow adequate grade for access to the street. Use Section 703 Asphaltic Concrete, of these Technical Specifications, as specified for the street paving.

When the finished surface of the existing drive is gravel, replacement shall be of like material. Payment shall be the same as Asphalt Driveways.

705-1. BASIS OF MEASUREMENT

Measurement shall be the number of square yards of Asphalt Driveways in place and accepted.

705-2. BASIS OF PAYMENT

Payment shall be the unit price per square yard for Asphalt Driveways as measured above, which price shall be full compensation for all work described in this section of the specifications and shall include all materials, equipment, tools, labor and incidentals necessary to complete the work.

706. CONCRETE CURBS

Concrete Curbs shall be constructed to the line, grade and dimensions as shown on the plans. Unless otherwise noted, all concrete curbs shall have fiber mesh reinforcement and have a minimum strength of 3000 psi at 28 days. Expansion joints shall be placed at intervals not to exceed a hundred feet (100') and scored joints shall be placed at intervals not to exceed ten feet (10'). In addition, all the requirements of these city Technical Specifications Sections 301, 302 and 303 shall also apply. The Contractor shall notify the Project Inspector a minimum of twenty-four (24) hours in advance of the placement of all concrete curbs.

The finished surface must have a reasonably uniform texture, must be within 1/4 inch of a true profile grade, and must have no deviation in excess of 1/4 inch from a straight edge applied to the pavement perpendicular to the centerline. Areas varying from a true surface in excess of the above stated tolerance may be accepted without correction if the Engineer determines that they were caused by preexisting conditions which could not reasonably have been corrected by the milling operations. Any unsuitable texture or profile, as determined by the Engineer, must be corrected by the Contractor at no additional expense to the city.

706-1. BASIS OF MEASUREMENT

The basis of measurement shall be linear feet of curb in place and accepted.

706-2. BASIS OF PAYMENT

Payment shall be the unit price per linear foot of curb, which price shall be full compensation for all work described in this and other applicable parts of the specifications and shall include all materials, equipment, tools, labor and incidentals necessary to complete the work.

707. CONCRETE SIDEWALKS AND DRIVEWAYS

707-1. CONCRETE SIDEWALKS

Concrete sidewalks shall be constructed to the line, grade and dimensions as shown on the plans or herein specified. Unless otherwise noted, all concrete sidewalks shall have fiber mesh reinforcement and have a minimum strength of 3000 psi at 28 days. Unless otherwise specified, all concrete sidewalks shall have a minimum width of four feet (4'). Concrete sidewalks shall have a minimum thickness of four inches (4''), except at driveway crossings where a minimum thickness of six inches (6'') is required. Also, 6/6 X 10/10 welded wire mesh reinforcement is required for all sidewalk that crosses driveways. The welded wire mesh shall be positioned in the middle to upper third of the placement. No compensation shall be given if the welded wire mesh is not properly placed. Expansion joints shall be placed at intervals of not more than 100 hundred feet and scoring marks shall be made every five feet (5'). Concrete shall be poured only on compacted subgrade prepared in accordance with Section 702 of these Technical Specifications. In addition, all the requirements of Sections 301, 302 and 303 of these Technical Specifications shall also apply.

707-2. CONCRETE DRIVEWAYS

Concrete driveways, whether new construction or replacement, shall be a minimum of six inches (6'') in thickness with 6/6 x 10/10 welded wire mesh reinforcement and a minimum horizontal distance between expansion joints of no less than four feet (4') measured in any direction. The welded wire mesh shall be positioned in the middle to upper third of the placement. No compensation shall be given if the welded wire mesh is not properly placed. Concrete shall be poured only on compacted subgrade prepared in accordance with *Section 702* of these Technical Specifications. In addition, all the requirements of *Sections 301, 302 and 303* of these Technical Specifications shall also apply.

The Contractor shall notify the Project Inspector a minimum of twenty-four (24) hours in advance of the placement of all concrete sidewalks and driveways.

707-3. CONCRETE CURB RAMPS

The contractor is responsible for constructing ADA compliant concrete curb ramps per the plans and installing detectable warning surfaces on said ramps as called for in the plan set. Concrete curb ramps and detectable warning surfaces are to be constructed per FDOT Standards and Specifications.

707-4. BASIS OF MEASUREMENT

The basis of measurement shall be the number of square feet of four inch (4") concrete sidewalk, six inch (6") concrete sidewalk, and six inch (6") concrete driveways in place and accepted.

707-5. BASIS OF PAYMENT

Payment shall be the unit price per square foot for each item as measured above, which shall be full compensation for all work described in this section and other applicable parts of the specifications and shall include all materials, equipment, tools, welded wire mesh where required, labor and incidentals necessary to complete the work.

708. MILLING OPERATIONS

708-1. EQUIPMENT, CONSTRUCTION & MILLED SURFACE

Unless otherwise noted in the specs, plans or this Section, the milling operation shall be performed in accordance with *Section 327 of FDOT's Standard Specifications*. The Contractor shall notify the city Project Manager a minimum of twenty-four (24) hours in advance of all milling.

708-2. ADDITIONAL MILLING REQUIREMENTS

The following are the additional milling requirements:

- A. If the milling machine is equipped with preheating devices, the Contractor is responsible to secure any necessary permits, and for complying with all local, state and federal environmental regulations governing operation of this type of equipment.
- B. All milled surfaces must be repaved within seven (7) days from the time it was milled, unless otherwise noted in the contract documents.
- C. Prior to paving, all milled areas shall be swept with a Municipal type sweeper either of the vacuum or the mechanical type that picks up and hauls off, dust and dirt. The sweeper must be equipped with its own water supply for pre-wetting to minimize dust. Moreover, the Contractor shall sweep debris off of sidewalks, driveways and curbs in addition to the roadways before leaving the job site.
- D. In cases where concrete valley swales are present, the adjoining pavement shall be milled to allow for the new asphalt grade to be flush with the concrete surface.
- E. The Contractor shall be responsible for removing any asphalt that remains in the curb line and/or median curbs after the milling operation of a street is complete. The cost of this removal shall be included in the bid item for milling.
- F. All radius returns on streets to be milled shall also be milled unless otherwise directed by the Engineer, with payment to be included in the bid item for milling.
- G. Any leveling or base replacement required after milling shall be applied to sections of the road as noted on the plans, or directed by the Engineer, per *Section 330 of FDOT's Standard Specifications*. The cost shall be included in the per ton unit cost for asphalt, unless otherwise noted in the project scope and plans.

- H. Any roadway base material exposed as a result of the milling operation shall be primed that same day (unless otherwise directed by the Engineer) per *Section 300 of FDOT's Standard Specifications*. Repairs required to said base that result from a failure to place the prime in a timely manner shall be done to the city's satisfaction, and at the Contractor's expense. No paving of the exposed base can commence until the city approves the repaired base. The cost of said prime shall be included in the bid item for milling.
- I. Prior to the placement of asphalt, the face of all curbs and driveways shall be tacked after the milling operation is complete.

708-3. SALVAGEABLE MATERIALS

Unless otherwise specified, all salvageable materials resulting from milling operations shall remain the property of the city. The transporting and stockpiling of salvageable materials shall be performed by the Contractor. The Contractor shall contact the city Project Manager to schedule delivery of material at least 48 hours prior to starting work.

708-4. DISPOSABLE MATERIALS

All surplus materials not claimed by the city shall become the responsibility of the Contractor. The Contractor shall dispose of the material in a timely manner and in accordance with all regulatory requirements in areas provided by the Contractor at no additional expense to the city.

708-5. ADJUSTMENT AND LOCATION OF UNDERGROUND UTILITIES

All private utilities and related structures requiring adjustment shall be located and adjusted by their owners at the owner's expense. city-owned utilities and structures shall be located by the Owner/City and adjusted by the contractor. The Contractor shall arrange their schedule to allow utility owners the time required for such adjustments (minimum 48 hours' notice per State Statute). All utility adjustments shall be completed prior to the commencement of milling and resurfacing operations.

708-6. ADJUSTMENT OF UTILITY MANHOLES

The necessary adjustments of sanitary sewer and stormwater utility manholes and appurtenances shall be accomplished by the Contractor in accordance with *Section IV, Sections 703-7* of the city's Technical Specifications.

708-7. TYPES OF MILLING

There are two types of milling used by the city:

- A. **Wedge** – This will consist of milling a six foot (6') wide strip along the curb line of the pavement adjacent to the curb so the new asphalt will align with the original curb height and pavement cross section.
- B. **Full Width** – This will consist of milling the entire roadway (i.e. curb line/edge of pavement to curb line/edge of pavement). All existing horizontal and vertical geometry shall remain unless otherwise indicated or approved by the Engineer.

708-8. MILLING OF INTERSECTIONS

Intersections, as well as other areas (including radius returns) are to be milled and repaved to restore and/or improve the original drainage characteristics. Said work should extend approximately fifty (50) feet from the low point of the existing swale.

708-9. BASIS OF MEASUREMENT

The quantity to be paid for will be the area milled, in square yards, completed and accepted.

708-10. BASIS OF PAYMENT

The unit price for milling shall include: all materials, preparation, hauling, transporting and stockpiling of salvageable materials, disposal of all surplus material, any required milling of radius returns and intersections, prime and/or tack coat either required or placed at Engineer's discretion, removal of asphalt from curbs, sweeping, labor, equipment, and all incidentals necessary to complete the milling in accordance with the plans and specifications.

800 SERIES: TRAFFIC SIGNALS, SIGNS AND MARKINGS

801. TRAFFIC SIGNAL EQUIPMENT AND MATERIALS

All traffic signal work shall be performed per *FDOT's Standard Specifications Sections 603 through 699*, unless otherwise specified in the contract documents and plans.

This specification includes, but is not limited to, the following items: all necessary equipment, materials, guaranties, acceptance procedures, signal timings, field tests, grounding, conduit, signal and interconnect cable, span wire assemblies, pull and junction boxes, electrical power service assemblies, poles, signal assemblies, pedestrian assemblies, inductive loop detectors, pedestrian detectors, traffic controller assemblies, controller cabinets and accessories, removal of existing traffic signal equipment, and internally illuminated signs.

All traffic signal installations shall be mast arms and conform to the requirements of FDOT's Mast Arm Assembly standard and shall be signed and sealed by a professional engineer registered in the State of Florida. All mast arm calculations, as well as the geotechnical report, shall also be signed and sealed by a professional engineer registered in the State of Florida. All mast arm colors shall be determined and approved by the city's Traffic Engineering Division prior to ordering from the manufacturer.

All traffic signal indicators for vehicles and pedestrians shall be LEDs and, approved by both the city's Traffic Engineering Division and FDOT. In addition to this, all pedestrian signal indicators shall utilize countdown features.

Contractor changes to the operation of an existing signal is prohibited unless directed by the city's Traffic Engineering Division.

All damaged inductive loop detectors shall be restored by the contractor per *FDOT Index 17781*.

801-1. BASIS OF MEASUREMENT AND PAYMENT

The basis of measurement and payment shall be specified in the contract documents and/or plans and shall include all equipment, preparation, materials, testing and incidentals required to complete the work per the plans.

802. SIGNING AND MARKING

All signing and marking work shall be performed per most current FDOT's Standard Specifications, unless otherwise specified in the contract documents and plans. This specification includes the following work: RPM's (*Section 706*), painted traffic stripes and markings (*Section 710*), thermoplastic stripes and markings (*Section 711*) and tubular delineators/flex posts (*Sections 705 and 972*).

The Contractor is responsible to ensure that striping is correctly placed. Errors in striping or markings shall be "blacked-out" with paint, unless otherwise directed by the Engineer. No payment will be made for these incorrect or "blacked-out" areas. Omissions in striping or markings shall be corrected to the city's satisfaction prior to any payment being made.

The Contractor is responsible for restoring all striping in paint and reflective beading per the FDOT indices mentioned above. The city's Traffic Engineering department shall follow up with thermoplastic striping at a later date unless otherwise specified.

802-1. BASIS OF MEASUREMENT AND PAYMENT

The basis of measurement and payment shall be specified in the contract documents and/or plans and shall include all equipment, preparation, materials, and incidentals required to complete the work per the plans.

803. ROADWAY LIGHTING

All roadway lighting shall be constructed per most current *Sections 715 and 992 of FDOT's Standard Specifications*, unless otherwise specified in the contract documents and plans.

803-1. BASIS OF MEASUREMENT AND PAYMENT

The basis of measurement and payment shall be specified in the contract documents and/or plans and shall include all equipment, materials, testing, and incidentals required to complete the work per the plans.

900 SERIES: LANDSCAPING/RESTORATION

901. WORK IN EASEMENTS OR PARKWAYS

Restoration is an important phase of construction, particularly to residents affected by the construction progress.

The Contractor will be expected to complete restoration activities within a reasonable time following primary construction activity. Failure by the Contractor to accomplish restoration within a reasonable time shall be justification for a temporary stop on primary construction activity or a delay in approval of partial payment requests.

Reasonable care shall be taken for existing shrubbery. Contractor shall replace all shrubbery removed or disturbed during construction. No separate payment shall be made for this work.

The Contractor shall make provision and be responsible for the supply of all water, if needed, on any and all phases of the contract work. The Contractor shall not obtain water from local residents or businesses except as the Contractor shall obtain written permission.

902. GENERAL PLANTING SPECIFICATIONS

902-1. IRRIGATION

902-1.1. DESCRIPTION

- A. The work specified in this Section consists of the installation of an automatic underground irrigation system as shown or noted in the plans. Provide all labor, materials, equipment, services and facilities required to perform all work in connection with the underground sprinkler irrigation system as indicated on the drawings and/or specifications. Work noted as “NIC”, “existing”, or “by others” is not included in this pay item.
- B. The irrigation plans are schematic in nature. Valves and pipes shall be located in the turf/landscape areas except at road/paving crossings. All piping under paving shall be sleeved. Changes in the irrigation system layout shall be modified with the approval of the Engineer.

902-1.1.1. QUALITY ASSURANCE

- A. The irrigation work shall be installed by qualified personnel or a qualified irrigation subcontracting company that has experience in irrigation systems of similar size, scope, mainline, system pressure, controls, etc.
- B. All applicable ANSI, ASTM, FEDSPEC Standards and Specifications, and all applicable building codes and other public agencies having jurisdiction upon the work shall apply.
- C. Workmanship: All work shall be installed in a neat, orderly, and responsible manner with the recognized standards of workmanship. The Engineer reserves the right to reject material or work which does not conform to the contract documents. Rejected work shall be removed or corrected at the earliest possible time at the Contractor’s expense.
- D. Operation and Maintenance Manuals: The Contractor shall prepare and deliver to the Engineer within ten (10) calendar days prior to completion of construction a minimum of three (3) hard cover binders, with three rings and a USB with the electronic design files (including the irrigation As Builts), containing the following information:
 1. Index sheet stating the Contractor’s address and business telephone number, twenty-four (24) hour emergency phone number, person to contact, list of equipment with name(s) and address(es) of

local manufacturer’s representative(s) and local supplier where replacement equipment can be purchased.

2. Catalog and part sheet on every material and equipment installed under this contract.
3. Complete operating and maintenance instructions on all major equipment.
4. Provide the Engineer and the city maintenance staff with a written the Operations Manual and “hands on” training for major equipment and show evidence in writing to the Engineer at the conclusion of the project that this service has been rendered.
 - a. Four-hour instruction (minimum) for the Irrigation Zones equipment operation and maintenance.
 - b. Two-hour instruction (minimum) for automatic control valve operation and maintenance.

902-1.1.2. PROJECT CONDITIONS

- A. The Contractor shall coordinate the work with all other trades, all underground improvements, the location and planting of trees and all other planting. Verify planting requiring excavation of twenty-four-inch (24”) diameter and larger with the Engineer prior to installation of main lines.
- B. Provide temporary irrigation at all times to maintain plant materials during the construction period.
- C. The Contractor is responsible to maintain the work area and equipment until final acceptance by the Engineer. Repairs and replacement of equipment broken, stolen, or missing as well as regular maintenance operations shall be the obligation of the Contractor.
- D. The Contractor shall submit a traffic control plan (per FDOT specifications) to the Engineer prior to initiating construction on the site. The Contractor shall be responsible for the maintenance of traffic signs, barriers, and any additional equipment to comply with the FDOT standards and to ensure the safety of its employees and the public.

902-1.1.3. WARRANTY

- A. The Contractor(s) shall warrant the irrigation system components to give satisfactory service for one (1) year period from the date of acceptance by the Engineer and the city. Should any problems develop within the warranty period due to inferior or faulty materials, the Contractor shall be corrected at no expense to the city.

902-1.2. PRODUCTS

902-1.2.1. GENERAL

- A. All materials throughout the system shall be new and in perfect condition. No deviations from the specifications shall be allowed except as noted.

902-1.2.2. PIPING

- A. The irrigation system pipe shall be as stated herein and shall be furnished, installed and tested in accordance with these specifications.
- B. All pipe is herein specified to be Polyvinyl Chloride (PVC) Pipe, 1120, Schedule 40, conforming to ASTM D2665 and D1785.
- C. All nipples, pipe connections, bushings, swing joints, connecting equipment to the mainline is required to be threaded Polyvinyl Chloride (PVC) Pipe, Schedule 80 per detail drawings.

902-1.2.3. PIPE FITTINGS

- A. All pipe fittings for Schedule 40 PVC pipe shall be as follows: Fittings shall conform to the requirements of ASTM D2466, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80. All fittings shall bear the manufacturer’s name or trademark, material designation, size, applicable IPS schedule and NSF seal of approval. The connection of mainline pipe

to the automatic control valve shall be assembled with threaded Schedule 80 fittings and threaded Schedule 80 nipples.

902-1.2.4. PVC PIPE CEMENT AND PRIMER

- A. Provide solvent cement and primer for PVC solvent weld pipe and fittings as recommended by the manufacturer. Pipe joints for solvent weld pipe to be belled end. Submit to the city Project Manager for approval. The solvent that cement that should be used is 303 PVC Cement Regular Clear.
- B. Purple primer shall be applied after the pipe and fittings have been cut and cleaned. The Primer shall be of contrasting color and be easily recognizable against PVC pipe. The purple primer cleaner for PVC is 8800.

902-1.2.5. THREADED CONNECTIONS

- A. Threaded PVC connections shall be made using Teflon tape or Teflon pipe sealant.

902-1.2.6. GATE VALVES

902-1.2.6.1. MANUAL GATE VALVES TWO INCHES (2") AND SMALLER

- A. Provide the following, unless otherwise noted on Drawings:
 - 1. 200-250 psi Ball Valve
 - 2. Nibco Brass Body Construction, female threaded on both sides, sized appropriately to source pipe - with Teflon Ball Seals
 - 3. Slip/Threaded Coupler
 - 4. Schedule 80 Nipple

902-1.2.6.2. GATE VALVES TWO AND A HALF INCHES (2½") AND LARGER

- A. Provide the following, unless otherwise noted on Drawings:
 - 1. AWWA-C509
 - 2. 200 lb. O.W.G.
 - 3. Cast Iron body - ASTM A 126 Class B
 - 4. Deep socket joints
 - 5. Rising stem
 - 6. Bolted bonnet
 - 7. Double disc
 - 8. Equipped with two inches (2") square operating key with tee handle
- B. Provide two (2) operating keys for gate valve three inches (3") and larger. The "street key" shall be five feet (5') long with a two inch (2") square operating nut.

902-1.2.7. SLEEVES

- A. Sleeves: (Existing by city of Clearwater)
 - 1. The Contractor shall verify the location of all existing sleeves as shown on the roadway, utility and/or irrigation plans and notify the Engineer of any discrepancies.
- B. Schedule 80 or higher, sized two (2) times the diameter of pipe to be sleeved

902-1.2.8. REMOTE CONTROL VALVES

- A. The electric globe remote control valve shall be a solenoid actuated; balance-pressure across-the-diaphragm type capable of having a flow rate per manufacturer's recommendations with a pressure loss not to exceed 6.1 pounds per square inch (psi). The valve pressure rating shall not be less than 150 psi. Submit to the city Project Manager for approval.

- B. The valve body and bonnet shall be constructed of high impact weather resistant plastic, stainless steel, and other chemical/UV resistant materials. The valve's one-piece diaphragm shall be of durable santoprene material with a clog resistant metering orifice.
- C. The valve body shall have a one-inch (1"), 1 1/2", 2", 3" (FNPT) inlet and outlet or a one-inch (1") female threaded inlet and outlet for threaded connections.
- D. The valve construction shall be as such to provide for all internal parts to be removable from the top of the valve without disturbing the valve installation.
- E. The valve shall be as manufactured by Irritrol or approved equal. Any valve that is 3" or larger than must submit to the city Project Manager for approval.
- F. Identify all control valves using Aluminum or Bronze metal I.D. tags numbered to match drawings.
- G. All electric valves to have gate valves on source side of each valve.

902-1.2.9. VALVE BOXES

- A. For electronic irrigation valves use a Brooks #36 concrete valve box with #36-T cast iron traffic bearing cover or approved equal.
- B. For wire splices and gate valves use a Carson with T cover (Heavy Duty) ten inch (10") circular valve box with #181015 cover comparable to Brooks or approved equal. The color of the lids need to be Pantone 522C if reclaimed.

902-1.2.10. AUTOMATIC CONTROL TIMER

- A. The irrigation controller (control module) shall be programmable by a separate transmitter device only. The program shall be communicated to the Control Module from the Field Transmitter via an infrared connection. The controller shall be of a module type which may be installed in a valve box underground. The controller shall function normally if submerged in water and the communication from the transmitter shall function if submerged in water.
- B. The control module shall be housed in an ABS plastic cabinet and shall be potted to insure waterproof operation. The control module shall have two mounting slots for screws allowing the module to be securely mounted inside a valve box.
- C. The controller shall operate on one nine volt (9V) alkaline battery for one full year regardless of the number of stations utilized. The controller shall operate 1, 2, or 4 stations either sequentially or independently.
- D. The controller shall have three (3) independent programs with eight (8) start times each, station run time capability from one (1) minute to twelve (12) hours in one (1) minute increments, and a seven (7) day calendar. The controller shall turn on stations via latching solenoids installed on the valves. Manual operations shall be initiated by attaching the Field Transmitter to the Control Module and programming a manual start. The controller shall be capable of manual single station or manual program operation.
- E. The controller shall be as manufactured by Rain Bird Sprinkler Mfg. Corp., Glendora, California USA. Submit to the city Project Manager for approval.

902-1.2.11. FIELD TRANSMITTER

- A. The irrigation controller shall be programmable by a separate transmitter device (Field Transmitter) only. The Field Transmitter shall communicate to the Control Module via an infrared connection or over air. The Field Transmitter shall be water resistant and housed in ABS plastic and have a removable, reversible protective sheath. The Field Transmitter shall operate on one nine volt (9V) alkaline battery.
- B. The Field Transmitter shall have a large LCD screen and a seven-key programming pad. A beep sound shall confirm every key stroke. The screen shall automatically turn off after one minute when not in use.
- C. The Field Transmitter shall be capable of programming an unlimited number of UNIK Control Modules or A/C placed times, whichever is applicable.

- D. The Field Transmitter shall be as manufactured by Rain Bird Sprinkler Mfg. Corp., Glendora, California USA.
- E. Field transmitter to be provided to city Parks and Recreation at time of acceptance of project.
- F. Submit to the city Project Manager for approval.

902-1.3. EXECUTION

902-1.3.1. GENERAL INSTALLATION REQUIREMENTS

- A. Before work is commenced, hold a conference with the Engineer to discuss general details of the work.
- B. Verify dimensions and grades at job site before work is commenced.
- C. During the progress of the work, a competent superintendent and any assistants necessary shall be on site, all satisfactory to the Engineer. This superintendent shall not be changed, except with the consent of the Engineer. The superintendent shall represent the Contractor in Contractor's absence and all directions given to the superintendent shall be as binding as if given to the Contractor.
- D. Obtain and pay for all irrigation and plumbing permits and all inspections required by outside authorities.
- E. All work indicated or notes on the Drawings shall be provided whether or not specifically mentioned in these Technical Specifications.
- F. No irrigation piping or any irrigation component shall be installed in a retention pond bottom or slopes or passing through retention pond. No piping shall be 12'' from top of bank.
- G. If there are ambiguities between the Drawings and Specifications, and specific interpretation or clarification is not issued prior to bidding, the interpretation or clarification will be made only by the Engineer, and the Contractor shall comply with the decisions. In the event the installation contradicts the directions given, the installation shall be corrected by the Contractor at no additional cost.
- H. Layout of sprinkler lines shown on the Drawing is diagrammatic only. Location of sprinkler equipment is contingent upon and subject to integration with all other underground utilities. Contractor shall employ all data contained in the Contract Documents and shall verify this information at the construction site to confirm the manner by which it relates to the installation.
- I. Do not proceed with the installation of the sprinkler system when it is apparent that obstructions or grade differences exist or if conflicts in construction details, legend, or specific notes are discovered. All such obstructions, conflicts, or discrepancies shall be brought to the attention of the Engineer.
- J. The disturbance of existing paving will not be permitted. Install all required sleeving prior to roadway base installation.

902-1.3.2. EXCAVATING AND BACKFILLING

902-1.3.2.1. TRENCHING - GENERAL

- A. Dig sides of trenches straight(vertically). Provide continuous support for pipe on bottom of trenches. Lay pipe to uniform grade. Trenching excavation shall follow layout indicated on Drawings.
- B. Maintain six inch (6'') horizontal and minimum clearance between sprinkler lines and between all lines of other trades.
- C. Do not install sprinkler lines directly above another line of any kind.
- D. Maintain six inch (6'') vertical minimum between sprinkler lines which cross at angles of 45° to 90°.
- E. Exercise care when excavating, trenching, and working near existing utilities.

902-1.3.2.2. BACKFILLING

- A. All pressure supply lines (mainline) shall have eighteen inches (18'') of fill placed over the pipe.
- B. Initial backfill on all lines shall be of a fine granular material with no foreign matter larger than one half inch (½'').
- C. Compact backfill according to Section 125 of FDOT Standard Specifications.

- D. Do not, under any circumstances, use equipment or vehicle wheels for compacting soil.
- E. Restore grades and repair damages where settling occurs before landscape installation begins.
- F. Compact each layer of fill with approved equipment to achieve a maximum density per AASHTO T180. Under landscaped areas, compaction shall not exceed 95% of maximum density.
- G. Compaction shall be obtained by the use of mechanical tampers or approved hand tampers. When hand tampers are used, the materials shall be deposited in layers not more than six inches (6") thick. The hand tampers shall be suitable for this purpose and shall have a face area of not more than 100 square inches. Special precautions shall be taken to prevent damage to the irrigation system piping and adjacent utilities.

902-1.3.2.3. ROUTING OF PIPING

- A. Routing of pressure and non-pressure piping lines are indicated diagrammatically on Drawings.
- B. Coordinate specimen trees and shrubs with routing of lines.
 - 1. Planting locations shall take precedence over sprinkler and piping locations.
 - 2. Report to Engineer and/or city any major deviation from routing indicated.
- C. Conform to Drawings layout without offsetting the various assemblies from the pressure supply line.
- D. Layout all systems using an approved staking method and maintain the staking of approved layout.

902-1.3.3. INSTALLATION

902-1.3.3.1. WATER SUPPLY

- A. Connections to the water sources shall be at the approximate locations indicated on the Drawings. Make minor changes caused by actual site conditions without additional cost to the city.

902-1.3.3.2. ASSEMBLIES

- A. Routing of pressure supply lines as indicated on Drawings is diagrammatic only. Install lines and required assemblies in accordance with details on Drawings.
- B. Do not install multiple assemblies on plastic lines. Provide each assembly with its own outlet. When used, the pressure relief valve shall be the last assembly.
- C. Install all assemblies in accordance with the respective detail Drawings and these Technical Specifications.
- D. Plastic pipe and threaded fittings shall be assembled using Teflon tape, applied to the male threads only.

902-1.3.3.3. SLEEVES: (EXISTING BY CITY OF CLEARWATER)

- A. The Contractor shall verify the location and size of all existing sleeves as shown on the roadway, utility and/or irrigation plans and notify the Engineer of any discrepancies before work begins.

902-1.3.3.4. PLASTIC PIPE

- A. Install plastic pipe in accord with manufacturer's recommendations.
- B. Prepare all welded joints with manufacturer's cleaner prior to applying solvent.
 - 1. Allow welded joints as least fifteen (15) minutes setup/curing time before moving or handling.
 - 2. Partially center load pipe in trenches to prevent arching and shifting when water pressure is on.
 - 3. Do not permit water in pipe until a period of at least four (4) hours has elapsed for solvent weld setting and curing, unless recommended otherwise by solvent manufacturer.
- C. Curing
 - 1. When the temperature is above 80°F, allow soluble weld joints at least twenty-four (24) hours curing time before water is introduced under pressure.
- D. Flushing the system:
 - 1. After all sprinkler pipelines and risers are in place and connected, open the control valves and flush out the system with a full head of water.
- E. Installing piping under existing pavement:

1. Piping under existing pavement may be installed by jacking & boring. Refer to *Section 503-2.3. of these Technical Specifications*.
2. Secure permission from the city Landscape Architect before cutting or breaking any existing pavement. All repairs and replacements shall be approved by city and shall be accomplished at no additional cost.

902-1.3.3.5. CONTROLLERS

- A. Install all automatic controllers as shown in the plans.
 1. The location of all controllers shall be approved by the city's Project Manager and/or Representative prior to installation.

902-1.3.3.6. REMOTE CONTROL VALVES

- A. Install at final grade. Set in turf areas whenever possible.
- B. Install valves in turf areas in a plumb position with twenty-four inch (24") minimum maintenance clearance from other equipment, three feet (3') minimum from edges of sidewalks, buildings, and walls, and no closer than seven feet (7') from the back of curb or edge of pavement along roadways.
- C. Contractor shall adjust the valve to provide the proper flow rate or operating pressure for each sprinkler zone.

902-1.3.3.7. GATE VALVES

- A. Install where indicated and with sufficient clearance from other materials for proper maintenance.
- B. Check and tighten valve bonnet packing before backfilling.
- C. Install in 10" round, Carson Heavy Duty valve box or approved equal (Pantone 522C if reclaim).

902-2. LANDSCAPE

902-2.1. GENERAL

902-2.1.1. REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with Federal, State, Local, and other duly constituted authorities, and regulatory agencies, without additional cost to the city in matters pertaining to codes, safety, and environmental matters.
- B. Any permits for the installation or construction of any of the work included under the contract, which are required by any of the legally constituted authorities having jurisdiction, shall be arranged for by the Contractor and paid for directly by the Contractor, unless otherwise agreed upon in writing.

902-2.1.2. SCOPE OF WORK

- A. All provisions of Contract, including General and Special Provisions and Plans, apply to the work specified in this Section. The Scope of Work includes everything for and incidental to executing and completing all landscape work shown on the Plans, Schedules, Notes and as specified herein.
- B. Furnish and provide all labor, plants and materials tools and equipment necessary to prepare the soil for plantings, to install and care for all plant materials (including finish grading if necessary); to remove and/or transplant existing plants if indicated; to furnish, plant, fertilize, guy and brace, water, mulch and prune all new plant materials; and to execute all other Work as described herein or indicated on the Plans.
- C. Work under this Section shall include labor and materials for final grading and raking to prepare the site for sodding, sprigging, or seeding, so finished lawn or playing field will appear even and uniform, will drain adequately, and will comply with the intent of the landscape drawings.
- D. Initial maintenance of landscape materials as specified in this document.

902-2.1.3. QUALITY ASSURANCE

- A. Landscape work shall be contracted to a single firm specializing in landscape work, who shall in turn subcontract no more than 40% of the work specified. All subcontractors under the control of the Contractor involved in the completion of the landscape work, shall be made known to the city and the city Landscape Architect prior to their commencement of work on the project.
- B. All work of this Section shall conform to the highest standard of landscape practices.
- C. The Plant Material Schedule included with these Plans is provided only for the Contractor's convenience; it shall not be construed as to conflict or predominate over the Plans. If conflict between the Plans and Specifications exists, submit to the city Project Manager for approval.
- D. During this work, the Contractor shall be responsible for maintaining safety among persons in their employ in accordance with the standards set by The Occupational Safety and Health Act of 1970 (and all subsequent amendments). City and city Landscape Architect shall be held harmless from any accident, injury or any other incident resulting from compliance or non-compliance with these standards.
- E. The Contractor shall cooperate with and coordinate with all other trades whose work is built into or affects the work in this Section.
- F. All appropriate utility companies and agencies shall be contacted 72 hours prior to excavation. Call "One Call"/ "Sunshine 811" at 8-1-1; "Sunshine 811" administrative offices may be reached at (800) 638-4097.
- G. The Contractor shall carefully examine the site and all existing conditions affecting the work, such as: soil, obstructions, existing trees, utilities, etc. Report any conditions in conflict with the work to the Landscape Architect.

902-2.1.4. SUBMITTALS

- A. The Contractor is required to submit prior to the expiration of the required maintenance period, two (2) copies of typewritten instructions recommending procedures to be established by the Contractor for maintenance of landscape work for a period of one (1) year.
- B. Furnish unit prices for all plant materials and inert materials, including labor for all specified work.

902-2.1.5. ALTERNATES, ADDITIONS, DELETIONS, SUBSTITUTIONS

- A. If there are additions/alternates included in these Plans and Specifications, the Contractor must propose prices to accomplish the work stated as additions/alternates at the time of bidding.
- B. The city, through their Project Manager, reserves the right to add or deduct any of the work stated herein without rendering the Contract void.
- C. The Contractor must have written approval by the city Project Manager for any substitutions not previously agreed to in the purchase agreement: installation without approval is entirely at the Contractor's risk.
- D. All material acquired through additions or substitutions shall be subject to all conditions and warranties stated herein.

902-2.1.6. ABBREVIATIONS/DEFINITIONS

- O.A. or HT.:*** The over-all height of the plant measured from the ground to the natural, untied state of the majority of the foliage, not including extreme leaves, branches or fronds.
- C.T.:*** Clear trunk is measured from the ground to the bottom of the first leaf or frond stem with no foliage from ground to specified height. For example, on Canary Island Date Palms or similar, the clear trunk measurement includes the "nut" at the base of the fronds.

C.W.: Clear wood is measured from the ground to the bottom of the base of the lowest leaf sheath or boot, trimmed in a natural manner. For example, on Canary Island Date Palms or similar, the clear wood measurement does not include the “nut” at the base of the fronds.

SPR.: Spread, branches measured in natural untied position to the average crown diameter, not including extreme leaves, branches, or fronds.

ST.TR.: Straight trunk.

MIN.: Minimum.

GAL.: Gallon container size, i.e., 1 gallon, 3-gallon, 7 gallons, etc.

O.C.: On center, distance between plant centers.

DIA.: Diameter.

LVS.: Leaves.

D.B.H.: Diameter or caliper of main trunk of tree as measured at breast height at 4-1/2 feet above grade.

CAL.: Caliper, the outside diameter of up to a four-inch tree is measured six inches above grade, larger trees are measured at 12 inches above grade.

B&B: Balled and burlapped in accordance with horticultural standards of the American Association of Nurserymen.

PPP: Plants per pot.

FG: Field grown.

STD.: Standard, single, straight trunk.

Owner: To be known as that entity which holds title or control to the premises on which the work is performed.

Owner’s Representative: Owner’s on-site representative shall be responsible for approval of quantity and quality of materials specified and execution of installation.

Contractor: Shall refer to that person or enterprise commonly known as the Landscape Contractor.

Landscape Architect: This person or firm is the responsible representative of the Owner who produces the landscape Plans and Specifications.

902-2.1.7. PRODUCT DELIVERY, STORAGE, AND HANDLING

902-2.1.7.1. PLANT MATERIALS

- A. Use Florida Grades and Standards (most current edition) for all plant materials within these Technical Specifications.
- B. Provide container-grown or, if appropriate, freshly dug trees and shrubs. Do not prune prior to delivery. Do not bend or bind trees or shrubs in such a manner as to damage bark, break branches or destroy natural shape. Provide protective covering during delivery. If plant delivery is made in open vehicles, the entire load shall be suitably covered.
- C. All plants are to be handled at all times so that roots or root balls are adequately protected from sun, cold, or drying winds. No root balls for trees and container plants that have been cracked or broken shall be planted except upon special approval. Plants shall not be pulled by the tops or stems, nor handled in a rough or careless manner at any time.
- D. Trees shall be dug with adequate root balls, burlapped, and wire bound if needed. Root pruning to be done a minimum of four (4) weeks before removal from the field and planting at the site. Root balls

may not be encased in “grow bags” or other synthetic material, except plastic shrink wrap for transport only.

- E. Palms shall be planted within twenty-four (24) hours of delivery.
- F. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and cover to keep the roots moist.
- G. Label all plants of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.
- H. Time delivery so that sod will be placed within twenty-four (24) hours after stripping. Protect sod against drying and breaking by covering palettes of sod or placing in a shaded area.

902-2.1.8. JOB CONDITIONS

902-2.1.8.1. ACCEPTANCE OF JOB CONDITIONS.

- A. The Contractor shall examine the sub-grade, verify elevations, observe the conditions under which work is to be performed and notify the city Landscape Architect or Project Manager in writing of unsatisfactory conditions prior to beginning work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the city Landscape Architect. Start of work shall indicate acceptance of conditions and full responsibility for the completed work.
- B. Proceed with and complete the landscape work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of landscape work and following the approved schedule. If seasonal limitations apply, notify the city Landscape Architect for adjustments to the Schedule.
- C. Determine locations of all underground utilities and review for conflicts with planting procedures before plant installations begin.
- D. When adverse conditions to plant growth are encountered, such as rubble fill, drainage conditions or obstruction, the Contractor shall notify the city Landscape Architect in writing for change approval before work is performed
- E. Plant trees and shrubs after final grades are established and prior to sod installation or seeding lawns. Protect existing lawn, trees, and promptly repair all damages from planting operations that is satisfactory and approved by the city.

902-2.1.8.2. SCHEDULING OF WORK

- A. The work shall be carried out to completion with the utmost speed. Immediately upon award of contract, the Contractor shall prepare a construction schedule and furnish a copy to the city’s Project Manager and/or the city Landscape Architect for approval. The Contractor shall carry out the work in accordance with the approved schedule.
- B. If the Contractor incurs unforeseen costs, such as overtime hours, holidays, etc., in order to complete the work within the time stated in the Contract, and/or to maintain the progress schedule, all said costs shall be borne by the Contractor at no additional cost to the city.
- C. The city’s Project Manager and/or Representatives may request work stoppage in writing. Upon written request from the city’s Project Manager, the Landscape Contractor shall suspend delivery of material and stop all work for such a period as deemed necessary by the city of Clearwater, the city’s Project Manager, or the General Contractor, with respect to any additional costs which may result from work stoppage.

902-2.1.8.3. UTILITIES

- A. The Contractor shall perform work in a manner which will avoid conflicts with utilities. Hand excavate, as required, to minimize possibility of damage to underground utilities. Maintain grade stakes set by others until removal is mutually agreed upon by all parties concerned.

902-2.2. PRODUCTS

902-2.2.1. MATERIALS

902-2.2.1.1. PLANT MATERIALS: NOMENCLATURE

- A. Plant species, sizes, etc., shall be per Plans and Specifications on Plant Material Schedule. Nomenclature is per Manual of Cultivated Plant, Standard Encyclopedia of Horticulture, L.H. Bailey, or Standardized Plant Names Dictionary, American Joint Committee on Horticultural Nomenclature (latest editions) or conforms with names accepted in the nursery trade. The scientific and common name both need to be provided for each plant materials.

902-2.2.1.2. PLANT MATERIALS: QUALITY ASSURANCE

- A. Use Florida Grades and Standards (latest edition) for all plant materials within these Technical Specifications.
- B. Provide healthy, vigorous stock grown under climatic conditions similar to conditions in the locality of the project. Plants shall have a habit of growth that is normal for the species and be sound, healthy, vigorous, and free from insects, pests or their eggs, plant diseases, defects and injuries. Plants shall be well branched and densely foliated when in leaf and shall have healthy, well-developed root systems.
- C. Trees shall be heavily branched or, in the case of palms, be heavily leafed. Some plant materials may be collected stock with the approval of the Landscape Architect. Tree species must have a single main trunk (central leader), unless otherwise stated. Trees that have the main trunk forming a “Y” shape or parallel branching are not acceptable.
- D. Plant materials shall be specified and shall be Florida #1 or better as to shape and quality for the species as outlined in Grades and Standards for Nursery Plants Part I and II, Florida Department of Agriculture and Consumer Services (latest edition).
- E. The city Landscape Architect reserves the right to inspect plant materials either at the place of growth or at the project site prior to planting for compliance with requirements for name, variety, size, quality, or designated area.
- F. Landscape materials shall be shipped with certificates of inspection as required by governmental authorities. The Contractor shall comply with all governing regulations that are applicable to landscape materials.
- G. Do not make substitutions. If specified landscape material is not available, submit to the Landscape Architect proof of it being non-available. In such event, if the Landscape Architect designates an available source, such shall be acquired from designated source. When authorized, a written change order for substitute material will be made by adjustment to Contract amount.
- H. Height and/or width of trees shall be measured from ground up; width measurement shall be normal crown spread of branches with plants in the normal position. This measurement shall not include immediate terminal growth. All measurements shall be taken after pruning for specified sizes. All trees and shrubs shall conform to measurements specified in the plant material schedule, except that plant material larger than specified may be used with the approval of the city Landscape Architect, with no increase to the Contract price. Plant materials shall not be pruned prior to delivery.
- I. Plant Material shall be symmetrical, typical for variety and species. Plants used where symmetry is required shall be matched as nearly as possible.
- J. Balled and burlapped plants shall have firm, natural balls of earth of sufficient diameter and depth to encompass the feeding root system necessary for full development of the plant and to conform with the standards of the American Association of Nurserymen. Root balls and tree trunks shall not be damaged by improper binding and B & B procedures. Only natural biodegradable burlap will be acceptable.
- K. Container-grown plants may be substituted for balled and burlapped plants or vice-versa provided the quality is equal or better than specified and the Landscape Architect approves the substitution.

- L. Container-grown stock shall have been grown in containers for at least four months, but not over two years. If requested, samples must be shown to prove no root bound condition exists.

902-2.2.1.3. GRASSES: SOD OR SEED

- A. Sod or seed (as/if specified) shall be a certified species as stated on the Plan. Solid sod shall be of even thickness and with a good root structure, 95% free of noxious weed, freshly mowed before cutting, and pest and disease free when laid. It must not be stacked more than twenty-four (24) hours before laying and it must be grown in soil compatible to that in which it will be installed. Sod must be kept moist prior to and after installation through the acceptance of the project.
- B. Sod shall be laid side to side with no gaps and all at level grade, so no scalping occurs. Contractor will make changes as deemed necessary by the city before acceptance of work.
- C. Seed shall be delivered to the site in unopened bags with certification tags in place. Purity, germination and weed content shall be as certification requirements.

902-2.2.1.4. MULCH

- A. Mulch shall be as specified in the plans
- B. Install mulch to an even depth of three inches (3") before compaction, as shown in the PLANTING DETAILS in the plans.

902-2.2.1.5. STAKES AND GUYS

- A. Use the University of Florida Urban Tree Foundation Planting Details and Specifications Staking details. Use the latest edition of the Staking Details from the Urban Tree Foundation (http://urbantree.org/details_staking.shtml)
- B. For single trunk palms, stakes shall be cut from 2" x 4" pressure treated (p.t.) stock, with a minimum of three (3) stakes per palm. Batten consisting of 5 layers of burlap and 5 - 2" x 4" by 16" wood connected with two – three-quarter inch ($\frac{3}{4}$ ") steel bands shall be used around the palm trunk. Submit to the city Project Manager for approval.
- C. Other tree staking systems may be acceptable if approved.

902-2.2.1.6. PLANTING SOIL

- A. Unless stated on the plans or in the specifications, install plant material in tilled and loosened native soil backfill. It is the responsibility of the Landscape Contractor to test, prior to planting and at no additional cost to the city, any soils which may be unsuitable for the vigorous growth of plants. Unsuitable conditions shall be reported to the Landscape Architect immediately in writing.
- B. When required, planting soil media shall be provided by the Contractor and shall consist of one-third (1/3) peat and two-thirds (2/3) sandy loam, with no lumps over one inch (1").
- C. Backfill and clean fill dirt provided by the Contractor shall be in a native, friable soil with known analysis and composition that is like soil makeup. There must be slight acid reaction to the soil (about 6.0 – 6.5 pH) with no excess of calcium or carbonate, and it shall be free from weeds, clay, stones, stumps, roots and toxic substances or any other materials that might be harmful to plant growth or a hindrance to grading, planting, and maintenance procedures and operations. No heavily organic soil, such as muck or peat shall be used as fill dirt.

902-2.2.1.7. TREE PROTECTION

- A. Wood fencing shall be 2" x 4" pressure treated stock with flagging on horizontal members. Space vertical members six feet (6') to eight feet (8') on center. The barricade shall be placed so as to protect the critical protection zone area, which is the area surrounding a tree within a circle described by a radius of one foot (1') for each inch of the tree's diameter at breast height DBH (four and one half feet) above grade.

902-2.2.1.8. ROOT BARRIER SYSTEM

- A. Submit to city Project Manager and Landscape Architect for approval (if applicable).

902-2.2.1.9. PACKAGED MATERIALS

- A. Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery and while stored at the site.

902-2.2.1.10. PESTICIDES

- A. Pesticides shall be only approved, safe brands applied according to manufacturer’s directions.

902-2.3. EXECUTION

902-2.3.1. PREPARATION

902-2.3.1.1. OBSTRUCTIONS BELOW GROUND

- A. It shall be the responsibility of the Contractor to locate and mark all underground utilities, irrigation lines and wiring prior to commencement of the work.
- B. If underground construction, utilities, or other obstructions are encountered in excavation of planting areas or pits, the city Project Manager and Landscape Architect shall be immediately notified to select a relocated position for any materials necessary.

902-2.3.1.2. GRADING AND PREPARATION FOR PLANT MATERIALS

- A. All proposed landscape areas containing existing turf grass or weeds shall be treated with mutually agreed herbicide per manufacturer’s specifications. All proposed landscape areas adjacent to water bodies shall be treated with “Rodeo” or approved equal per the manufacturer’s specifications.
- B. New plant materials will not be installed until 98% weed/turf eradication has been achieved. More than one application may be required to produce an acceptable planting bed.
- C. Pre-emergent herbicides are not a substitute for spray treatment of “Rodeo” or approved equal and may be used only with the written approval of the Landscape Architect.
- D. Should any plant material in the same or adjacent beds be damaged by these chemicals, the same size, quantity, and quality of plants shall be immediately replaced by the Contractor at no cost to the city.
- E. Any necessary corrections or repairs to the finish grades shall be accomplished by the Contractor. All planting areas shall be carefully graded and raked to smooth, even finish grade, free from depressions, lumps, stones, sticks or other debris and such that they will conform to the required finish grades and provide uniform and satisfactory surface drainage without puddling.
- F. The Contractor shall remove debris (sticks, stones, rubbish) over one- and one-half inches (1½”) in any dimension from individual tree, shrub and hedge pits and dispose of the excavated material off the site.

902-2.3.1.3. PREPARATION FOR ANNUAL BED PLANTING

- A. Prepare native subgrade by rototilling or loosening by hand methods. Spread three inches (3”) of one-third (1/3) Florida peat and two-thirds (2/3) sandy, or other approved organic soil amendment over the full length and width of planting area for annuals. Rototill organic layer six inches (6”) to eight inches (8”) into the native soil. Grade the planting bed by “crowning” to ensure that surface drainage, percolation, and aeration occur at rapid rates.

902-2.3.1.4. PREPARATION FOR SEEDING AND SOD AREAS

- A. All proposed sod areas containing existing turf grass or weeds shall be treated with Monsanto’s “Round-Up” per manufacturer’s specifications. All proposed sod areas adjacent to water bodies shall be treated with “Rodeo” per the Manufacturer’s Specifications.

- B. Limit preparation to areas which will be planted promptly after preparation. Loosen sub-grade of seed and sod areas to a minimum depth of four inches (4”).
- C. Immediately prior to any turf work, the Contractor shall finish grade the soil to a smooth, even surface assuring positive drainage away from buildings and the subsequent turf flush to the tops of adjacent curbs and sidewalks. The surface shall be sloped to existing yard drains.
- D. Moisten prepared seed and sod areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.

902-2.3.2. INSTALLATION

902-2.3.2.1. BERM CONSTRUCTION (IF SPECIFIED)

- A. Install berms at location and design shown on Plans and at the height and slope indicated. Height stated is for finished berm with soil at natural compaction.
- B. Exact location and configuration of berms may require modification to allow proper drainage; such changes will be coordinated with the Landscape Architect.
- C. If shown on the Plan, construct berms using clean sandy loam fill dirt which is well-drained, free of rocks, roots, or other debris, with a soil pH of an acid Nature (about 6.0 - 6.5). No heavily organic soil, such as muck or peat shall be used in berm construction.

902-2.3.2.2. LAYOUT OF PLANT MATERIALS

- A. Unless otherwise stipulated, plant materials shall be approximately located per the plans by scale measurements using established building, columns, curbs, screen walls, etc., as the measuring reference point. Slight shifting may be required to clear wires, prevent blockage of signage, etc.
- B. Shrubs and ground covers shall be located and spaced as noted on the plant material schedule
- C. Leave an eighteen-inch (18”) (450 millimeters) borders of mulched space between outer leaves of installed plant material and the bed line, curb, or building foundation wall for all plant sizes.
- D. Any necessary “minor” adjustments in the layout of planting shall be made by the Contractor with the approval of the city Project Manager and Landscape Architect in order to conform as nearly as possible to the intent of the Plans.

902-2.3.2.3. PLANTING PROCEDURES

- A. All shrubs, trees and ground covers or vines shall be planted in pits having vertical sides and being circular in outline. Planting pit shall be two (2) times the width of the root ball.
- B. Plants shall be set straight or plumb, in the locations shown, planted “high” with 10% of the root ball height above the surrounding grade.
- C. Native soil shall be used in back-filling plant pits or as specified. The Contractor shall be responsible for providing additional soil for building tree saucers.
- D. When balled and burlapped plants are set, undisturbed native soil shall be left under the base of the root ball to prevent voids. Backfill loosened native soil around the sides of the root ball. Remove the top 4 four inches (4”) (100 millimeters) of burlap wire, and all tie-down material from the root ball. Do not remove these materials from the bottom of the root ball. Thoroughly water-in before bringing the backfill up to the proper grade. Use the Florida Grades and Standards (latest edition). Failure to comply is cause for rejection.
- E. Containerized plants shall be installed with undisturbed native soil left under the base of the root ball to prevent voids. Planting pit shall be three (3) to five (5) times the width of the root ball. Backfill tilled and loosened native soil around the sides of the root ball. Thoroughly water-in before bringing the backfill up to the proper grade.
- F. Plant spacing shall be “on center” and varies with the different plant species. Space each variety of plant equally in the planting areas. Shrubs and ground cover adjacent to straight or curved edges shall be triangular - spaced in rows parallel to those edges. Plant a minimum of eighteen inches (18”) from the back of the curb to the outside edge of the plant.

902-2.3.2.4. SODDING

- A. During periods of drought, sod shall be watered sufficiently at its origin to moisten the soil adequately to the depth to which it is to be cut.
- B. Solid sod shall be laid tightly with closely abutting staggered joints with an even surface edge and sod edge, in a neat and clean manner to the edge of all the paving and shrub areas. Cut down soil level to one inch (1”) to one- and one-half inches (1-1/2”) below top of walks prior to laying sod.
- C. Within two (2) hours after installing sod and prior to rolling, irrigate the sod. Sufficient water shall be applied to wet the sod thoroughly and to wet the sod to a depth of two inches (2”) (50 millimeters). Watering shall be done in a manner that will avoid erosion due to the application of excessive quantities, and the watering equipment shall be a type that will prevent damage to the finished sod surface. Watering shall be repeated as necessary to keep sod moist until rooted to subgrade.
- D. The sod shall be pressed firmly into contact with the sod bed using a turf roller or other approved equipment so as to eliminate air pockets, provide a true and even surface and insure knitting without any displacement of the sod or deformation of the surfaces of sodded areas. After the sodding operation has been completed and rolled, the edges of the area shall be smooth and conform to the grades indicated.
- E. If, in the opinion of the Landscape Architect, top dressing is necessary after rolling, clean silica sand shall be used to fill voids. Evenly apply sand over the entire surface to be leveled, filling-in dips and voids and thoroughly washing into the sod areas.
- F. On slopes 3:1 or steeper, and as required, a geotextile fabric shall be installed per manufacturer’s specifications prior to placing sod. The sod shall be fastened in place with suitable wooden pins or by other approved method.

902-2.3.2.5. SEEDING

- A. Seed shall be installed per the specifications of the State of Florida Department of Transportation. See plan for type of seed.

902-2.3.2.6. TREE GUYING, BRACING AND STAKING

- A. Use the latest edition of the Staking Details from the Urban Tree Foundation (http://urbantree.org/details_staking.shtml). Submit to the city Project Manager for approval.
- B. Contractor shall remove all tree guying, staking, and bracing from trees 1 year after the date of final acceptance of the landscape work.

902-2.3.2.7. MULCHING

- A. All planting beds shall be weed-free prior to mulching.
- B. All plant beds and tree rings shall be mulched evenly with a three inch (3”) layer (before compaction) of 1.5” round pine bark nuggets or brown shredded hard wood mulch, or other mulch as specified on the Plans or General Notes. Submit to the city Project Manager for approval.
- C. Mulch shall not be placed against the trunks of plant materials or foundations of buildings. Maintain a minimum six-inch (6”) clearance for trees and shrub trunks and a minimum six-inch (6”) clearance for the walls of buildings.

902-2.3.2.8. CLEAN-UP

- A. During landscape work, store materials and equipment where directed by the city.
- B. The Contractor shall promptly remove any materials and equipment used on the job, keeping the area neat at all times. Upon completion of all planting, dispose of all excess soil and debris leaving pavements and work areas in safe and orderly condition.
- C. The clean-up of the site shall include the removal and proper disposal of the tree guying, staking, and bracing materials as described in specifications. No pruning should be done by the contractor, but can be done by the landscape contractor.

902-2.3.2.9. PROTECTION

- A. The Contractor shall provide safeguards for the protection of workmen and others on, about, or adjacent to the work, as required under the parameters of the Occupational Safety and Health Administration (OSHA) standards.
- B. The Contractor shall protect the city's and adjacent property from damage.
- C. The Contractor shall protect the landscape work and materials from damage due to landscape operations. Maintain protection during installation and maintenance periods.
- D. The Contractor shall provide protection (tree barricades) for all existing trees and palms as specified.

902-2.3.2.10. REPAIR OF DAMAGES

- A. The Contractor shall repair all damage caused by their operations to other materials, property, or trades to a level equal in quality to the existing condition prior to damage.
- B. The Contractor shall be held responsible for all damage done by their work or employees to other materials or trades' work. Patching and replacement of damaged work may be done by others, at the city's direction, but the cost of same shall be paid by the Contractor who is responsible for the damage.

902-2.3.3. MAINTENANCE

- A. The Contractor shall maintain all plant materials in a first-class condition from the beginning of landscape construction until Final Acceptance.
- B. Operations:
 1. Maintenance shall include, but not be limited to, watering of turf and planting beds, mowing, fertilizing, cultivation, weeding, pruning, disease and pest control, replacement of dead materials, straightening, turf or planter settlement corrections, replacement of rejected materials, staking and guying repair and tightening, wash-out repairs and regrading, and any other procedures consistent with the good horticultural practice necessary to insure normal, vigorous and healthy growth of all work under the Contract. Mowing shall be consistent with the recommended height per the University of Florida Cooperative Extension Service.
 2. Within the warranty period, the Contractor shall notify the city of any maintenance practices being followed or omitted which would be detrimental to the healthy, vigorous growth of the landscape.
 3. The Contractor shall be responsible for the final watering of not less than one inch (1") of water for all planted materials before leaving the site.

902-2.3.4. INSPECTION, REJECTION, AND ACCEPTANCE**902-2.3.4.1. INSPECTION**

- A. Upon completion of the installation, the Contractor will notify the city or the city's Project Manager that the job is ready for inspection. Within fifteen (15) days of notifications, the installation will be inspected by the Landscape Architect. A written and/or graphic inspection report will be sent to the city and/or Landscape Contractor.

902-2.3.4.2. REJECTION AND REPLACEMENT

- A. The Landscape Architect shall be final judge as to the suitability and acceptability of any part of the work. Plant material will be rejected if it does not meet the requirements set forth in the Plans and Specifications.
- B. Replace any rejected materials immediately or within fifteen (15) days and notify the Landscape Architect that the correction has been made.

902-2.3.4.3. ACCEPTANCE

- A. After replacement of rejected plant material, if any, have been made, and completion of all other correction items, the city or Project Manager will accept the project in writing.

- B. Upon Final Acceptance, the city assumes responsibility for maintenance within the terms of the Contract. Acceptance will in no way invalidate the Contractor’s warranty period.
- C. The Contractor’s warranty period will begin after final acceptance of the project by the Owner.
 - 1. If evidence exists of any lien or claim arising out of or in connection with default in performance of this Contract, the city shall have the right to retain any payment sufficient to discharge such claim and all costs in connection with discharging such claim.
 - 2. Where the Specifications call for any stipulated item or an “approved equivalent”, or in words to that effect, the Contractor shall indicate the price of the type and species specified in the proposal, giving the price to be added or deducted from their Contract price. The final selection rests with the city or their representative.
 - 3. Where plants installed do not meet specifications, the city reserves the right to request plant replacement or an appropriate deduction from the Contract amount to compensate for the value not received from the under-specified plant materials. No additional compensation will be made to the Contractor for plants installed that exceed specifications.

902-2.3.5. WARRANTY

- A. The Contractor shall warranty all palms and trees furnished under this contract for a period of one (1) year and all shrubs for a period of six (6) months. Material which is either dead or in poor health during this period or at completion will be replaced at no charge to the city. Should any of the plant materials show 50% or more defoliation during the warranty period, due to the Contractor’s use of poor quality or improper materials or workmanship, the Contractor upon notice, shall replace without delay same with no additional cost to the city. Should any plant require replacing, the new plant shall be given the equal amount of warranty.

903. SODDING

Unless otherwise noted herein, the Contractor shall place all sod, either shown on the plans or at the direction of the Engineer, in conformance with the latest editions of *Sections 575, 981, 982 and 983 of FDOT’s Standard Specifications*. The area for sod application shall be loosened and excavated to a suitable depth and finished to a grade compatible with existing grass and structures. Sod shall be placed with edges in contact and shall be compacted to uniform finished grade with a sod roller immediately after placement. In sloped areas, the sod shall be graded and placed so as to prohibit erosion and undermining of the adjacent sidewalk. No sod that has been cut for more than seventy-two (72) hours can be used. The city shall be notified in advance by 2 business days and reserves the right to view and inspect the sod before installation. A city Project Manager shall inspect the sod at the site once delivered and will not be allowed to be laid until approved. The sod shall be thoroughly watered immediately after placement. The Contractor shall continue to water sod as needed and/or directed by the Engineer as indicated by sun exposure, soil, heat, and rain conditions, to establish and assure growth, until termination of the contract. Dead sod, or sod not acceptable to the Engineer, shall be removed and replaced by the Contractor at no additional compensation. Any questions concerning the type of existing sod shall be determined by the Engineer.

Unless otherwise noted on the plans, payment for sod (including labor, equipment, materials, placement, rolling, watering, etc.) shall be included in other bid items. Payment for these associated bid items may be withheld until the Contractor provides the city a healthy, properly placed stand of grass. When this work is given as a separate bid item, it shall cover all labor, equipment and materials, (including water) required for this work and shall be paid for on the basis of each square foot in place and accepted. No payment for sod shall be made until the Contractor provides the city a healthy, properly placed stand of grass.

904. SEEDING

Seed, or seed and mulch, shall only be used when specified for certain demolition projects. The seed and/or mulch shall be placed as called for on the plans in the following manner. The area to be seeded shall be brought to the required line and grade, fertilized, and seeded in basic conformance with *FDOT's Standard Specifications Sections 570, 981, 982 and 983*. However, no wildflower seed shall be used, and Argentine Bahia Seed shall be used instead of Pensacola Bahia. No sprigging will be required. Also, the addition of 20 lb. of Rye Seed (to total 60 lb. of seed per acre) will be required during the stated periods. It is also required that the Contractor maintain said seed until growth is assured.

When this work is given as a bid item, the item shall cover all labor, material, equipment (including water), required for this work, and shall be paid for on the basis of each square yard in place and accepted. If called for on the plans, but not shown as a bid item, then the cost of such work as stated above shall be included in the cost of other work.

905. LAWN MAINTENANCE SPECIFICATIONS

905-1. SCOPE

To remove trash and debris from landscape and paved area; maintenance and fertilization of plant beds and landscape materials; maintenance, repair, and operation of irrigation systems; ornamental pest control; palm pruning; maintenance of traffic; and the cleaning of hard surfaces at designated areas. The Contractor is to work with the city in coordinating maintenance activities and reporting irregularities in the work zone.

The Contractor(s) will provide the labor and materials required to maintain the specified landscaped street areas including:

- Traffic safety and Maintenance of Traffic.
- Trash and debris removal from the job site.
- Removal of weeds in landscaped areas and hard surfaces.
- Proper trimming and pruning of landscape plants and palms.
- Proper fertilization and pest control of landscape and palms (may be subcontracted).
- Irrigation service and repair.
- Mulch replacement.
- Cleaning of hard surfaces; and the
- Reporting of irregularities at the job site.

905-2. SCHEDULING OF WORK

The Contractor(s) shall accomplish all landscape maintenance required under the contract between the hours of 7:00 a.m. and 6:00 p.m. Monday through Saturday, excluding observed holidays. The city may grant, on an individual basis, permission to perform contract maintenance at other hours.

All work shall be completed in a continuous manner, such as cleanup, weeding, trimming, etc., be completed before leaving the job site.

905-3. WORK METHODS

905-3.1. MAINTENANCE SCHEDULING

The Contractor(s) will adhere to a work schedule provided by the city (see Level of Service). Any variations to that schedule, requested by either party, must be approved, either verbally or in writing by an authorized representative of the other party.

905-3.2. DUTIES PER SERVICE VISIT

The Contractor(s) shall provide the following service at each scheduled visit to the designated location:

905-3.2.1. LITTER AND DEBRIS

Remove trash and debris from the project site. Proper disposal of collected trash and debris is the Contractor's responsibility. Extraordinary amounts of debris caused by hurricanes, tornadoes, vandalism, etc., would be the responsibility of the city to clean up. The Contractor should report such accumulations of debris when they are encountered. Bids for the extraordinary cleanup from the Contractor would be considered. Work sites should be left in a clean and neat appearance upon completion. All debris from pruning process is to be removed from the job site and disposed of by the Contractor.

905-3.2.2. VISUAL CHECK

The site should be checked for irregularities, such as irrigation leaks, vehicle damage, dead or damaged plant material, vandalism, etc., which should be reported to the city within twenty-four (24) hours after providing the service.

905-3.2.3. PLANT TRIMMING AND PALM PRUNING

All plant material should be trimmed in a manner that promotes the natural shape and mature size of the particular species. Trimming should be performed at intervals that will maintain plants in a neat appearance. Trimming should be performed to promote fullness of the plants, while maintaining height restrictions in Clear Sight Zones as established on the landscape plans. Plants shall be kept trimmed to the back of curb. Brown foliage shall be removed from Liriope.

Palm pruning to be performed at least once per year, preferably in late June or July following flower formation, consistent with the following specification.

1. PHOENIX SPECIES (CANARY DATE, INDIA DATE, PYGMY DATE, ETC.):

Remove all descending fronds, to the base of the frond; all parallel and ascending fronds are to remain in order to leave a full, rounded head; seed heads may remain, but remove old faded heads that are encountered in the pruning process; and remove loose frond boots; remove vegetation, such as strangler figs, Brazilian Pepper, Asparagus fern, etc., growing in the frond boots or on the trunk. Provide the rounded, classic cut on all Medjool palm boots. No climbing spikes allowed on palms.

905-3.2.3.1. TRAFFIC CONTROL

Proper and safe work zones in vehicular traffic areas are to be set up and maintained by the Contractor, according to the approved Maintenance of Traffic specifications.

905-3.2.3.2. PEDESTRIAN SAFETY

Contractor is responsible for maintaining safe work zones in areas where pedestrian and park users are present. The city reserves the right to limit the hours of operation in certain high pedestrian use areas.

905-3.2.4. WEED REMOVAL IN LANDSCAPED AREA

Weeds should be removed on a regular basis in order to keep them from being visibly noticeable. Weed control with the use of appropriate herbicides is allowable, given they are properly applied by a certified applicator. Herbicide damage to landscape material will be remedied by Contractor at their expense.

905-3.2.5. MULCH CONDITION

Should be maintained at a thickness that will discourage weed growth as well as help retain soil moisture, usually three inches (3”).

905-3.2.6. IRRIGATION SERVICE AND REPAIR

Should be performed at each visit to assure the system’s proper operation and timing. Drip tubing should be kept covered with mulch. Timer should be checked for proper time of day and operating schedule. Leaks or breaks in the system should be repaired before the next scheduled system running time.

905-3.2.7. LAWN AND ORNAMENTAL PEST CONTROL

Should be performed by a properly licensed and certified applicator to keep pest populations at a less than damaging level. Landscape materials lost to or extensively damaged by pests will be replaced by the Contractor at the Contractor’s expense. Diazinon products are not to be used on city properties.

905-3.2.8. PALM FERTILIZATION

Apply three (3) pounds of Magnesium sulfate and one pound of Potassium evenly, per tree, across the root zone (typically within the dripline), annually in early February.

905-3.2.9. FREEZE PROTECTION

The city will provide a freeze/frost protection fabric for the Contractor to install over freeze/frost sensitive plants (Lantana and Pentas). The covering material will be stored at a city facility. Contractor will remove the covering material from storage and install over the sensitive plants, securely fastening edges of the material to the ground per manufacturer’s directions. The city will furnish metal pins needed for securing fabric to the ground. The city will notify the Contractor one (1) day or twenty-four (24) hours minimum prior to the need to protect plant material. After uses, the Contractor will prepare the fabric for storage and return it to the designated city facility. Protective covering shall be removed the following afternoon or remain in place as directed by the city. The city shall notify the Contractor by 11:00 a.m. about removing the cover or keeping it in place due to continued freezing temperatures. The city may cancel the freeze protection event at any time prior to the end of the scheduled installation day (5:00 p.m.) The Contractor will be compensated for the number of hours mobilization or on-site work at the contracted rate per man-hour unit price. The Contractor shall provide a unit price for the installation and removal of the covering fabric on a per event basis, as well as an hourly rate per employee required. The city and Contractor will coordinate appropriate irrigation operations with weather conditions. Should freeze/frost damage occur, the Contractor shall perform remedial work as per unit basis, as directed by the city.

906. LEVEL OF SERVICE

The Project Site is to be serviced weekly. Repairs to damage or vandalism to be made within seven (7) working days of reported irregularity. Weekly visits should occur no closer than six (6) and no further than ten (10) calendar days apart.

907. COMPLETION OF WORK

Within twenty-four (24) hours of completing work, notify the city Project Manager either in writing of said completion and request the substantial completion letter.

908. INSPECTION AND APPROVAL

Upon receiving notification from the Contractor, the city shall inspect the serviced location the following business day. If, upon inspection, the work specified has not been completed, the city shall contact the Contractor to indicate the necessary corrective measures. The Contractor will be given forty-eight (48) hours from this notification to make appropriate corrections. If the work has been completed successfully then the city will pay for services billed.

909. SPECIAL CONDITIONS

1. This location will be newly installed and under warranty by the installer for a twelve (12) month period on plants, trees, and palms. Landscape installer will coordinate irrigation operation with the Maintenance contractor to assure adequate irrigation to the landscape materials. Installer will also be responsible for the untying of palm heads/fronds as they feel appropriate.
2. All listed acreage or square footage figures are estimates.
3. All work shall be performed in a good and workmanlike manner, consistent with trade practices and standards which prevail in the industry.
4. The Contractor shall be responsible for damage to any plant material or site feature caused by the Contractor or their employees. The Contractor shall be notified in writing of the specific nature of the damage and cost of repair. The city shall, at its option, invoice the Contractor for the payment, or reduce by the amount of the repairs on the next regular payment to the Contractor.
5. Occasionally circumstances (standing water, prolonged inclement weather, parked vehicles, etc.) may make all or portions of a location unserviceable during the regular schedule. The Contractor shall notify the city Supervisor of such occurrences and shall schedule to perform the required work to the location as soon as the pertaining circumstances are relieved.

910. TREE PROTECTION

910-1. TREE BARRICADES

- A. A protective barrier shall be placed around all protected trees and palms prior to land preparation or construction activities within or adjacent to the work zone, including all staging and/or lay down areas. Protective barriers shall be installed as follows:
 1. At or greater than the full dripline of all species of Mangroves and Cabbage Palms.
 2. At or greater than the full dripline or all protected native pine trees and other conifer species.
 3. At or greater than two-thirds (2/3) of the dripline of all other protected species
 4. At or greater than the full dripline of trees within a specimen tree stand.
- B. Protective barriers are to be constructed using no less than two-inch (2") lumber for upright posts. Upright posts are to be at least four feet (4') in length with a minimum of one foot (1') anchored in the ground. Upright posts are to be placed at a maximum distance of eight feet (8') apart. Horizontal rails are to be constructed using no less than one-inch (1") by four-inch (4") lumber and shall be securely attached to the top of the upright post. The city's Project Manager must approve any variation from the above requirements.

- C. Whenever a protective barrier is required, it shall be in place until all construction activity is terminated. The area within the barrier limits shall remain undisturbed by any activity during construction. Native ground cover and understory vegetation existing within the barriers shall remain throughout construction. Exotic plant species may only be removed by manual labor utilizing hand tools or by other means if authorized in writing by the city's Project Manager
- D. Prior to the erection of any required protective barrier, all surface foreign material, trash or debris shall be removed from the area enclosed by the barrier, and after erection of the barrier no such material or litter shall be permitted to remain within the protected area. No equipment, chemicals, soil deposits or construction materials shall be placed within such protective barriers.
- E. No signs, building permits, wires, or other attachments of any kind shall be attached to any protected tree or palm.
- F. At all times, due care shall be taken to protect the critical root zone of trees protected by this section, and root pruning requirements shall apply to such trees.

910-2. ROOT PRUNING

- A. Where proposed construction improvements involve excavation and/or impacts to the critical root zone of protected trees, the Contractor shall be required to have an International Society of Arboriculture (ISA) certified arborist perform, or directly supervise root pruning to reduce the impacts of construction. The critical root zone is equivalent to the tree's dripline. Prior to any clearing, grubbing or excavation activities, the affected roots must be severed by clean pruning cuts at the point where grubbing or excavation impacts the root system. Roots can be pruned utilizing specified root pruning equipment designed for that purpose or by hand digging a trench and pruning roots with a pruning saw, chain saw, or other equipment designed for tree pruning. Root pruning by trenching equipment or excavation equipment is strictly prohibited. Roots located in the critical root zone that will be impacted by construction activities shall be pruned to a minimum depth of eighteen inches (18") below existing grade or to the depth of the proposed impact if less than eighteen inches (18") from existing grade. Any questions should be addressed to the city's Project Manager.
- B. Root pruning shall only be performed by or under the direct supervision of an International Society of Arboriculture (ISA) certified arborist.
- C. Any proposed root pruning trenches shall be identified on site (i.e. staked or painted) inspected and approved by the city's Project Manager and/or Representative prior to actual root pruning.
- D. Root pruning shall be performed as far in advance of other construction activities as is feasible, but at a minimum shall be performed prior to ANY impacts to the soil. Associated tree protection measures should be implemented upon completion of said root pruning.
- E. If there is a likelihood of excessive wind and/or rain exceptional care shall be taken on any root pruning activities.
- F. Root pruning shall be limited to a minimum of ten inches (10") per one inch (1") of the trunk diameter from the tree base. Any exception must be approved by the city's Project Manager prior to said root pruning.
- G. Roots shall be cut cleanly, as far from the trunk of the tree as possible. Root pruning shall be done to a minimum depth of eighteen inches (18") from existing grade, or to the depth of the disturbance if less than eighteen inches (18").
- H. Root pruning shall be performed using a root cutting machine specifically designed for this purpose. Alternate equipment or techniques must be approved by the city's Project Manager, prior to any work adjacent to trees to be preserved.
- I. Root pruning shall be completed, inspected, and accepted prior to the commencement of any excavation or other impacts to the critical root zones of trees to be protected.
- J. Excavations in an area where root are present shall not cause the tearing or ripping of tree roots. Roots must first be cleanly severed prior to continuing with the excavation or tunneled around to prevent damage to the root.

- K. Tree roots shall not be exposed to drying out. Root ends shall be covered with native soil or burlap and kept moist until final backfill or final grades has been established.
- L. When deemed appropriate (e.g., during periods of drought) the city Project Manager may require a temporary irrigation system be utilized in the remaining critical root zones of root pruned trees.
- M. When underground utility lines are to be installed within the critical root zone, the root pruning requirement may be waived if the lines are installed via tunneling or directional boring as opposed to open trenching.

910-3. PROPER TREE PRUNING

- A. All tree pruning and/or root pruning on existing trees to remain shall only be performed by or under the direct supervision of an International Society of Arboriculture (ISA) certified arborist. Furthermore, all tree work shall conform to the American National Standards Institute (ANSI) 2001, American National Standard for tree care operations – Tree, Shrub, and other Woody Plant Maintenance – Standard practices (pruning) ANSI A-300.
- B. Proper pruning techniques for all lateral branches of protected trees are required. Flush cuts (pruning cuts that remove the branch collar) and stub cuts (cuts that leave a stub on the tree) are improper techniques. Any protected tree that has been improperly pruned will not be recognized as a tree left on the project in a healthy growing condition and will require replacement consistent with the current City Code of Ordinances and Community Development Code.
- C. No protected tree shall have more than thirty percent (30%) of its foliage removed.
- D. No protected tree shall be topped, hat raked, or lion tailed. Any protected tree that has been improperly pruned will not be recognized as a tree left on the project in a healthy growing condition and will require replacement consistent with the current City Code of Ordinances and Community Development Code.
- E. Tree Trunks and limbs shall be protected. The use of tree spikes or other devices that damage trunk and bark tissue on protected trees shall be prohibited. Any protected tree that has been damaged in such a manner will not be recognized as a tree left on the project in a healthy growing condition and will require replacement consistent with the current City Code of Ordinances and Community Development Code.

911. IRRIGATION SYSTEM DESIGN

The requirements for Irrigation System Design are the following:

- A. The application rate must not exceed the ability of the soil to absorb and retain the water applied during any one application.
- B. The design operating pressure must not be greater than the available source pressure.
- C. The design operating pressure must account for peak use times and supply line pressures at final buildout for the entire system.
- D. Distribution devices and pipes should be designed for optimum uniform coverage. The first and last distribution device should have no more than a 10% difference in flow rate. This usually corresponds to about a 20% difference in pressure.
- E. “Head to head” placement of sprinklers to achieve 100% coverage.
- F. Flexibility must exist to meet a site’s peak water requirements and allow for the modification of the system’s operation to meet seasonal irrigation changes or local restrictions.
- G. Distribution equipment (such as pop-ups, rotors, bubblers and drip) in a given zone must have the same precipitation rate.
- H. Turf and landscape areas should be zoned separately based on plant water requirements. Bubblers, drip, rotors and pop-ups will all be on separate zones.
- I. All water delivery devices (heads, tree bubblers, valves) shall be free of buried obstructions 8-10” below each device to be acceptable.

- J. Install valves in Turf areas where possible
- K. Install all irrigation heads at finish grade unless approved by Parks and Rec. **before installation.**
- L. The design package should include a general irrigation schedule with recommendations and instructions on modifying the schedule for local climatic and growing conditions.
- M. If required by plant species, the design should account for the need to leach out salt buildup from poor quality water.
- N. Water supply systems (such as wells and pipelines) should be designed for varying control devices, and backflow prevention.
- O. Water conveyance systems should be designed with thrust blocks and air release valves, such that **flow velocity is 5 feet per second or less.**
- P. Pipelines should be designed to provide the system with the appropriate pressure required for maximum irrigation uniformity.
- Q. Pressure regulating or compensating equipment must be used where the system pressure exceeds the manufacturer’s recommendations.
- R. Equipment with check valves must be used in low areas to prevent low head drainage.
- S. A rain-sensing device must be used to automatically shut off system when raining.
- T. Non-planted areas, including impervious surfaces should not be irrigated.
- U. The city of Clearwater, Parks and Beautification must approve irrigation plan before irrigation construction begins.

912. IRRIGATION SYSTEM INSTALLATION

The requirements for Irrigation System Installation are the following:

- A. Only qualified specialists under the direct supervision of a “Certified Irrigation Designer” or a “Certified Irrigation Contractor” should install the irrigation system. Certifications are through “The Irrigation Association”.
- B. The construction must be consistent with the design.
- C. The designer must approve any design changes before construction.
- D. Construction and materials should meet existing standards and criteria.
- E. **Mainline** – To be laid with tracking wire / tape firmly attached throughout project. Leave 18” of excess cable at terminal ends in 6” round valve boxes. See Parks and Rec Irrigation Spec page for type.
- F. Sleeve size will be 2 times the diameter of pipe to be sleeved. Example 1.5” feed pipe dia. = 3” sleeve diameter.
- G. Acceptable safety practices must be followed during construction.
- H. All underground cables, pipes and other obstacles should be identified, and their locations flagged.
- I. Obtain all permits before construction.
- J. Always give the city Engineering and Parks & Recreation Department a copy of the As-Built plans, operating manuals, warranties, and written instructions on how to change the irrigation system’s timers/clock/controllers.
- K. At the end of construction, the site must be cleaned of all construction materials.

- J. Install valves in Turf areas where possible
- K. Install all irrigation heads at finish grade unless approved by Parks and Rec. **before installation.**
- L. The design package should include a general irrigation schedule with recommendations and instructions on modifying the schedule for local climatic and growing conditions.
- M. If required by plant species, the design should account for the need to leach out salt buildup from poor quality water.
- N. Water supply systems (such as wells and pipelines) should be designed for varying control devices, and backflow prevention.
- O. Water conveyance systems should be designed with thrust blocks and air release valves, such that **flow velocity is 5 feet per second or less.**
- P. Pipelines should be designed to provide the system with the appropriate pressure required for maximum irrigation uniformity.
- Q. Pressure regulating or compensating equipment must be used where the system pressure exceeds the manufacturer’s recommendations.
- R. Equipment with check valves must be used in low areas to prevent low head drainage.
- S. A rain-sensing device must be used to automatically shut off system when raining.
- T. Non-planted areas, including impervious surfaces should not be irrigated.
- U. The city of Clearwater, Parks and Beautification must approve irrigation plan before irrigation construction begins.

912. IRRIGATION SYSTEM INSTALLATION

The requirements for Irrigation System Installation are the following:

- A. Only qualified specialists under the direct supervision of a “Certified Irrigation Designer” or a “Certified Irrigation Contractor” should install the irrigation system. Certifications are through “The Irrigation Association”.
- B. The construction must be consistent with the design.
- C. The designer must approve any design changes before construction.
- D. Construction and materials should meet existing standards and criteria.
- E. **Mainline** – To be laid with tracking wire / tape firmly attached throughout project. Leave 18” of excess cable at terminal ends in 6” round valve boxes. See Parks and Rec Irrigation Spec page for type.
- F. Sleeve size will be 2 times the diameter of pipe to be sleeved. Example 1.5” feed pipe dia. = 3” sleeve diameter.
- G. Acceptable safety practices must be followed during construction.
- H. All underground cables, pipes and other obstacles should be identified, and their locations flagged.
- I. Obtain all permits before construction.
- J. Always give the city Engineering and Parks & Recreation Department a copy of the As-Built plans, operating manuals, warranties, and written instructions on how to change the irrigation system’s timers/clock/controllers.
- K. At the end of construction, the site must be cleaned of all construction materials.

SECTION IVa

SUPPLEMENTARY TECHNICAL SPECIFICATIONS

The Technical Specifications of the Construction Contract; Articles 100 through 910 inclusive; are a part of this contract.

The following supplements modify, change, delete from or add to the Technical Specifications of the Construction Contract. Where any article of the Technical Specifications is modified or any paragraph, subparagraph or clause thereof is modified or deleted by these supplements, the unaltered provisions of that article, paragraph, subparagraph or clause shall remain in effect.

MODIFICATIONS TO TECHNICAL SPECIFICATIONS – SECTION IV

ARTICLES 100-910

Basis for measurement and payment for all Articles shall be superseded by Division 01 33 00 in Section IVa Supplemental Technical Specifications.

ARTICLE 103 - DEFINITION OF TERMS

Add to the definition of “Estimated Quantities” the following statement:

The basis of payment for work and materials will be the actual amount of work done and materials furnished. Contractor agrees that he will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and materials actually furnished and the estimated amounts thereof.

ARTICLE 202 - OBSTRUCTIONS

Revise the 3rd sentence to read:

Any survey monument or benchmark which must be disturbed shall be carefully referenced before removal, and unless otherwise provided for, shall be replaced upon completion of the work by a Florida registered Professional Surveyor and Mapper (PSM).

The following divisions are included as part of supplemental technical specifications.

DIVISION 00

00 00 03 Certification Pages00 00 03-1 - 3

DIVISION 1 GENERAL

01 11 13 Summary of Work.....01 11 13-1 - 4
01 20 00 Measurement and Payment01 20 00-1 – 6

01 25 13	Substitutions and Product Options	01 25 13-1 – 4
01 31 00	Mobilization	01 31 00-1 – 1
01 31 19	Coordination	01 31 19-1 – 1
01 33 00	Shop Drawings, Project Data and Samples	01 33 00- 1 - 5
01 40 00	Quality Control.....	01 40 00-1 – 3
01 45 29	Testing Laboratory Services.....	01 45 29-1 – 3
01 50 00	Temporary Facilities	01 50 00-1 – 3
01 71 23	Field Engineering	01 71 23-1 – 2
01 73 29	Cutting and Patching	01 73 29-1 – 2
01 77 00	Contract Closeout.....	01 77 00-1 – 2

DIVISION 2 – SITE WORK

02 41 00	Demolition	02 41 00-1 – 4
----------	------------------	----------------

DIVISIONS 3 – CONCRETE

03 30 00	Cast in Place Concrete.....	03 30 00-1 – 28
03 30 10	Anchor Systems	03 30 10-1 – 11
03 35 00	Concrete Finishing	03 35 00-1 – 3
03 60 00	Grouting.....	03 60 00- 1 - 4

DIVISION 4 – MASONRY

04 40 00	Masonry.....	04 40 00- 1 – 13
----------	--------------	------------------

DIVISION 5 – METAL

05 40 00	Cold Formed Metal Framing.....	05 40 00-1 - 9
05 50 00	Metal Fabrications	05 50 00- 1 –10
05 51 00	Structural Aluminum	05 51 00- 1 – 5
05 52 10	Pipe and Tube Railings	05 52 10- 1 – 9

DIVISION 7 – THERMAL MOISTURE PROTECTION

07 90 00	Sealants and Caulking	07 90 00 1 – 4
----------	-----------------------------	----------------

DIVISION 8 - OPENINGS

08 11 16	Aluminum Doors and Frames.....	08 11 16 1 – 7
----------	--------------------------------	----------------

DIVISION 9 – PAINTING AND COATINGS

09 21 16	Gypsum Board Assemblies	09 21 16 1 – 4
09 65 10	Resilient Tile Flooring.....	09 65 10-1 - 7
09 69 00	Access Flooring.....	09 69 00-1 – 7

09 90 00 Painting and Coatings09 90 00-1 – 56

DIVISION 26 – ELECTRICAL

26 00 00 Electrical Basic Requirements.....26 00 00-1 –14
26 00 01 Electrical Demolition.....26 00 10-1 - 11
26 00 05 Short Circuit Coordination and Arc Flash Analysis.....26 00 05-1 - 10
26 00 10 Testing and Commissioning of Electrical Systems26 00 10-1 - 10
26 00 15 Identification for Electrical Systems.....26 00 15-1 - 16
26 05 01 Excavation and Concrete Work for Electrical Systems26 00 15-1 - 7
26 05 19 Low-Voltage Power and Control Wire and Cable.....26 05 19-1 - 10
26 05 26 Grounding and Bonding26 05 26-1 - 5
26 05 29 Electrical Hangers and Supports.....26 05 29-1 - 5
26 05 30.10 Electrical Cable Installation in Raceway Systems..... 26 05 33.10 – 1-10
26 05 33.13 Electrical Raceway Systems 26 05 33.13 – 1-15
26 05 33.16 Boxes, Cabinets and Enclosures for Electrical Systems 26 05 33.16 – 1-8
26 05 33.17 Manholes, Handholes, and Pullboxes 26 05 33.17 – 1-9
26 05 36 Cable Trays for Electrical Systems26 05 36 – 1-7
26 05 43 Underground Ductbanks for Electrical Systems.....26 05 43 – 1-5
26 22 00 Dry Type Transformers 600V26 22 00 – 1-7
26 24 13 Switchboards.....26 24 13 – 1-9
26 24 16 Panelboards26 24 16 – 1-6
26 24 19 Low-Voltage Motor Control Centers26 24 19 – 1-20
26 36 23 Automatic Transfer Switch26 36 23 – 1-15
26 43 00 Surge Protective Devices-600V26 43 00 – 1-8

DIVISION 31 EARTHWORK

31 31 16 Termite Control.....31 31 16 – 1-3

END OF SUPPLEMENTARY TECHNICAL SPECIFICATIONS

SECTION 00 00 03 – CERTIFICATION PAGES

PROFESSIONAL ENGINEER’S CERTIFICATION FOR AUBREY HAUDRICOURT, PE

**PROJECT NAME: CITY OF CLEARWATER NE WRF MCC-1, DC 1 AND 2
REPLACEMENT**

The following sections of the Technical Specifications in the Issued for Bid submittal for the above referenced project were prepared under my direction and supervision.

DIVISION 1 GENERAL

01 11 13 Summary of Work
01 20 00 Measurement and Payment
01 25 13 Substitutions and Product Options
01 31 00 Mobilization
01 31 19 Coordination
01 33 00 Shop Drawings, Project Data and Samples
01 40 00 Quality Control
01 45 29 Testing Laboratory Services
01 50 00 Temporary Facilities
01 71 23 Field Engineering
01 73 29 Cutting and Patching
01 77 00 Contract Closeout

DIVISION 2 – SITE WORK

02 41 00 Demolition

DIVISION 26 – ELECTRICAL

26 00 00 Electrical Basic Requirements
26 00 01 Electrical Demolition
26 00 05 Short Circuit Coordination and Arc Flash Analysis
26 00 10 Testing and Commissioning of Electrical Systems
26 00 15 Identification for Electrical Systems
26 05 01 Excavation and Concrete Work for Electrical Systems
26 05 19 Low-Voltage Power and Control Wire and Cable
26 05 26 Grounding and Bonding
26 05 29 Electrical Hangers and Supports
26 05 30.10 Electrical Cable Installation in Raceway Systems
26 05 33.13 Electrical Raceway Systems
26 05 33.16 Boxes, Cabinets and Enclosures for Electrical Systems
26 05 33.17 Manholes, Handholes, and Pullboxes
26 05 36 Cable Trays for Electrical Systems
26 05 43 Underground Ductbanks for Electrical Systems

- 26 22 00 Dry Type Transformers 600V
- 26 24 13 Switchboards
- 26 24 16 Panelboards
- 26 24 19 Low-Voltage Motor Control Centers
- 26 36 23 Automatic Transfer Switch
- 26 43 00 Surge Protective Devices-600V

Aubrey Haudricourt, P.E.
Florida Professional Engineer No. 66861
McKim & Creed, Inc.
1365 Hamlet Avenue
Clearwater, Florida 33756



c=US, o=MCKIM AND
CREED INC.,
dnQualifier=A01410C
0000017CB76570AA0
00022DA, cn=aubrey
A haudricourt
2024.01.20 11:03:50
-05'00'

PROFESSIONAL ENGINEER'S CERTIFICATION FOR A EMMETT ANDERSON III, PE

**PROJECT NAME: CITY OF CLEARWATER NE WRF MCC-1, DC 1 AND 2
REPLACEMENT**

The following sections of the Technical Specifications in the Issued for Bid submittal for the above referenced project were prepared under my direction and supervision.

DIVISIONS 3 – CONCRETE

03 30 00 Cast in Place Concrete
03 30 10 Anchor Systems
03 35 00 Concrete Finishing
03 60 00 Grouting

DIVISION 4 – MASONRY

04 40 00 Masonry

DIVISION 5 – METAL

05 50 00 Metal Fabrications
05 51 00 Structural Aluminum
05 52 10 Pipe and Tube Railings

DIVISION 7 – THERMAL MOISTURE PROTECTION

07 90 00 Sealants and Caulking

DIVISION 9 – PAINTING AND COATINGS

09 90 00 Painting and Coatings



Digitally signed by
Augustus E Anderson
Date: 2024.01.19
13:46:56-05'00'

A.Emmett Anderson, III P.E.
Florida Professional Engineer No. 34779
McKim & Creed, Inc.
7785 Baymeadows Way
Suite 101
Jacksonville, FL 32256

PROFESSIONAL ENGINEER'S CERTIFICATION FOR JOHN E CHRISTIE, AIA

**PROJECT NAME: CITY OF CLEARWATER NE WRF MCC-1, DC 1 AND 2
REPLACEMENT**

The following sections of the Technical Specifications in the Issued for Bid submittal for the above referenced project were prepared under my direction and supervision.

DIVISION 5 – METAL

05 40 00 Cold Formed Metal Framing

DIVISION 8 - OPENINGS

08 11 16 Aluminum Doors and Frames

DIVISION 9 – PAINTING AND COATINGS

09 21 16 Gypsum Board Assemblies

09 65 10 Resilient Tile Flooring

09 69 00 Access Flooring

DIVISION 31 - EARTHWORK

31 31 16 Termite Control

John E. Christie, AIA
Florida Professional Architect No. AR-0016722
Christie & Christie Inc.
135-19th Avenue SE
St. Petersburg, Florida 33705

SECTION 01 11 13 – SUMMARY OF WORK

PART 1 – GENERAL

1.1 LOCATION AND DESCRIPTION OF WORK

- A. The Work is being performed for the City of Clearwater (CITY).
- B. The Work is located at the City of Clearwater NE APC facility.
- C. The Work to be performed under this Contract includes, but is not limited to, constructing the Work outlined below and specifically detailed in all related specifications and drawings. The major Work can be described as follows:

The creation of a separate Electrical Room with double doors access within the existing Control Building electrical area. Electrical Room to be air conditioned with a raised “data center” floor capable of supporting the electrical equipment. Room will have mezzanine floor with staircase, refer to Architectural.

New fire rated access door to Blower Room from Control Building electrical area and modifications to existing concrete floor to address subsidence. Refer to Structural.

The replacement and relocation of the 2nd Anoxic Mixer motor control center (MCC-1) and the switchgear distribution centers (DC-1 and DC-2) to be installed in new electrical room. Removal of existing FRP structure with existing MCC-1. Conduits on Anoxic Basin to be replaced and redirected to new MCC-1 location.

Project includes a new 1200A Nema 4X 316 SS Service Entrance Breaker with new Utility transformer connection (Service Transformer to remain but reset for leveling); new ASCO Automatic Transfer Switch, NEMA 12 switchboards, “Smart” MCC, Integral Power Center, panelboards, and Trystar generator load bank tap box, all associated concrete ductbanks, handholes, and cable trays. Project also includes incorporation of “Smart” MCC into existing SCADA system which will require programming services.

Existing ATS shall be offered to City for salvage.

As part of structural portion of the project a concrete block wall and footer will be replaced due to failure with a new grade beam foundation and CMU block. Equipment attached to the wall will need to be detached, temporarily repowered, and supported and then replaced and reconnected to ne integrated power center. Replacement of some additional equipment as noted on drawings is also a part of this effort.

Equipment and mechanical piping under Blower Room plenum area to be removed and piping capped. With respect to the under floor drains in this area, they are to be removed and replaced. Blower Room plenum area is then to be filled in along with under the intake structure which is to be removed. Refer to drawings.

Contractor responsible for maintenance of plant operations, provide any or all temporary power or controls connections, which may include temporary primary generation and standby power equipment.

1.2 CONSTRUCTION CONTRACT

- A. Contracting Method: Work shall be constructed under one prime Contractor. Contractor shall, self-perform over 50% percent of the total labor work using their own workforce.

1.3 WORK BY OTHERS

- A. Other construction contracts have been or will be awarded by CITY that are in close proximity to or border on the Work of this Contract. Work under these other contracts is briefly described as follows:

1. Influent MCC replacement as part of the EQ Tank replacement along with the EQ Tank project.

1.4 WORK BY CITY

- A. Plant Staff will perform the following in connection with the Work:
 1. Remove all stored equipment from construction areas. This will include shelving.
 2. Operate all existing equipment, and appurtenances that will affect CITY's operation, unless otherwise specified or indicated.

1.5 CITY FURNISHED EQUIPMENT AND MATERIALS

- A. Items of equipment and materials to be furnished by CITY for installation by CONTRACTOR are:

1. None.

1.6 ASSIGNED PROCUREMENT CONTRACTS

- A. Contracts for procurement of goods described in this paragraph will be assigned to CONTRACTOR as specified in the Agreement.

1. None.

1.7 SEQUENCE AND PROGRESS OF WORK

- A. Demolition of existing electrical equipment not used as room modifications progress. Temporary power connections will be required. All equipment must be kept functioning unless directed by the City.
- B. Removal of concrete wall between Maintenance Room and Control Building Electrical area. Temporary power connections will be required. All equipment must be kept functioning unless directed by the City.
- C. Construction of concrete footer.
- D. Install ductbank from Anoxic Basin to new MCC location. Install of raised floor in electrical room to support switchboard, MCC, Integral Power Center.
- E. Installation of Main Service entrance breaker and conduit connections to transformer and new ATS location. Install of ductbank between Generator and ATS location. Install ATS and Trystar Tap equipment.
- F. Install cable tray between main breaker, generator Trystar Tap box and new electrical room.
- G. Install MCC and other switchboard, Integrated power center and panelboards.
- H. Install block wall as shown on drawings.
- I. Construct new Electrical Room with mezzanine.

1.8 CONTRACTOR'S USE OF SITE

- A. CONTRACTOR's use of the Site shall be confined to the areas defined in the pre-bid meeting. Within 10 days of Notice to Proceed, Contractor shall submit a markup of the site plan showing the proposed storage area.
- B. Move stored products that interfere with operations of CITY, County, other contractors, and others performing work for CITY.

1.9 EASEMENTS AND RIGHTS-OF-WAY

- A. Easements and rights-of-way will be provided by CITY in accordance with the General Conditions. Confine construction operations within CITY's property, public rights-of-way, easements obtained by CITY, and the limits shown. Use care in placing construction tools, equipment, excavated materials, and materials and equipment to be incorporated into the Work to avoid damaging property and interfering with traffic. Do not enter private property outside the construction limits without permission from the owner of the property.

1.10 NOTICES TO CITY AND AUTHORITIES OF PROPERTIES ADJACENT TO THE WORK

- A. Notify owners of adjacent property and utilities when prosecution of the Work may affect their property, facilities, or use of property.
- B. When it is necessary to temporarily obstruct an entrance to property, or when utility service connection will be interrupted, provide notices sufficiently in advance to enable affected persons to provide for their needs. Conform notices to Laws and Regulations and, whether delivered orally or in writing, include appropriate information concerning the interruption and instructions on how to limit inconvenience caused thereby.
- C. Notify utility owners and other concerned entities at least 10 full business days prior to cutting or closing streets, lane closures or other traffic areas or excavating near Underground Facilities or exposed utilities.

1.11 SALVAGE OF EQUIPMENT AND MATERIALS

- A. Existing equipment and materials removed and not shown or specified to be reused in the Work will become CONTRACTOR's property, unless otherwise stated. See any exceptions above in Scope.
- B. Existing equipment and materials removed by CONTRACTOR shall not be reused in the Work, except where so specified or indicated.
- C. Carefully remove in manner to prevent damage all equipment and materials specified or indicated to be salvaged and reused or to remain property of CITY. Store and protect salvaged items specified or indicated to be used in the Work. Replace in kind or with new items equipment, materials, and components damaged in removal, storage, or handling through carelessness or improper procedures.
- D. CONTRACTOR may furnish and install new items, with CITY's approval, instead of those specified or indicated to be salvaged and reused, in which case such removed items will become CITY's property of first right of refusal.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 20 00 – MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A. The total Bid Price shall cover all Work required by the Contract Documents. All costs in connection with the proper and successful completion of the Work, including furnishing all materials, equipment, supplies, and appurtenances; providing all construction equipment and tools; and performing all necessary labor and supervision to fully complete the Work, shall be included in the lump sum and unit prices bid. All Work not specifically set forth as a pay item in the Bid Form shall be considered a subsidiary obligation of Contractor and all costs in connection therewith shall be included in the prices bid.
- B. This section covers methods of measurement and payment for items of Work under this Contract.

1.2 ESTIMATED QUANTITIES

- A. All estimated quantities stipulated in the Bid Form or other Contract Documents are approximate and are to be used only (a) as a basis for estimating the probable cost of the Work and (b) for the purpose of comparing the bids submitted for the Work. The actual amounts of work done, and materials furnished under unit price items may differ from the estimated quantities. The basis of payment for work and materials will be the actual amount of work done and materials furnished. Contractor agrees that he will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and materials actually furnished, and the estimated amounts thereof, as described in the supplementary conditions.

1.3 EXCAVATION

- A. Except where otherwise specified, the lump sum and unit price bid for each item of Work which involves excavation or trenching shall include all costs for such Work. No direct payment shall be made for excavation or trenching. All excavation is unclassified and there shall be no separate payment for excavation of rock or for backfill where rock is excavated below subgrade.

1.4 TAXES AND PERMITS

- A. The Bidder's attention is directed to the fact that the tax laws of the State of Florida, including but not limited to Chapter 212, Florida Statutes, apply to this bid matter and that all applicable taxes and fees shall be deemed to have been included in the Bidder's proposal.

1.5 RETAINAGE

Refer Contract Documents, Section II.14.1 Application for Progress Payment .

1.6 MEASUREMENT AND PAYMENT

A. Refer to the Contract Documents.

1. Bid Item No. 1 - Mobilization/Demobilization

- a. The lump sum amount for this Bid Item shall include all labor, material, and equipment necessary for the Contractor to mobilize and demobilize. Mobilization shall be the preparatory work and operations in mobilizing for beginning work on the project, including, but not limited to, those operations necessary for the movement of personnel, equipment, supplies and incidentals to the project site, construction videos, and for the establishment of temporary offices, storage buildings, staging areas, construction fencing, silt fence, safety equipment and first aid supplies, sanitary and other facilities, as required by the Contract Documents and applicable laws and regulations. The costs of bonds, required insurance, permits and any other preconstruction expense necessary for the start of the work, excluding the cost of construction materials, shall also be included in this item. Demobilization shall be the work of removing temporary facilities, project signs, erosion control, temporary fencing, etc. from the site.
- b. The price bid for mobilization shall not exceed ten percent (10%) of the total contract cost bid. Partial payments for this item will be made in accordance with the following schedule:

<u>Percent of Original Contract Amount Earned</u>	<u>Allowable Percent of the Lump Sum Price for the Item</u>
5	25
10	50
25	75
50	100

These payments will be subject to the standard retainage provided in the agreement. Payment shall be made under Item No. 1 Payment of the retainage will be made after completion of the work and demobilization.

2. Bid Item No. 2A – Demolition, Excavation and Backfill

- a. The lump sum amount for this Bid Item shall include all labor, material, and equipment necessary for the removal of:

- (i) Equipment as shown on drawings.
- (ii) A new doorway between Electrical and Blower rooms as shown on drawings.
- (iii) A concrete block wall due to failure. Equipment attached to the wall will need to be detached, temporarily supported, and energized until replaced with new.
- (iv) All underground ductbanks shown on drawings.
- (v) Blower Room floor sections as shown on drawings.
- (vi) Blower Room Plenum demolition work, including Air Intake Structure, ancillary equipment, and pipe removal. Floor drain piping removal for Plenum filling and drain piping replacement.

- b. Excavation and Compacted Fill for all ductbanks, footings and Plenum Area's.

Work to be performed per the drawings and per the Contract Documents or as otherwise necessary for the completion of the Work associated with this Contract.

Payment for this item shall be Lump Sum

- 3. Bid Item No. 2B – Concrete and Beams

- a. The lump sum amount for this Bid Item shall include all labor, material, and equipment necessary for the replacement of a concrete block wall due to failure, with a new grade beam foundation and CMU block. Equipment previously attached to the wall will need to be temporarily supported and kept energized. Once wall is completed, rewiring and conduit replacement can commence including reconnection of some existing and new electrical and mechanical equipment is a part of this effort. Work to be performed per the drawings and per the Contract Documents or as otherwise necessary for the completion of the Work associated with this Contract.

Payment for this item shall be Lump Sum

- 4. Bid Item No. 3A – HVAC

- a. Shall include all labor, materials, and equipment necessary for the installation of a fully functional "Split System" HVAC in the new Electrical Room, including outdoor concrete pad, piping, supports, start-up, testing, training, manuals and spare parts, and other ancillary items necessary as called out on the drawings and per the Contract Documents.

Payment for this item shall be lump sum.

5. Bid Item No. 3B – Room Improvements

- a. Description: The unit price amount for this Bid Item shall include all labor, material, and equipment necessary to install a separate electrical room with mezzanine floor within the existing Control Building electrical area. This room will be airconditioned with a raised “data center” floor capable of supporting the electrical equipment. Work includes but not limited to walls, ceilings, flooring, lighting, doors and railing, gypsum wallboard, mezzanine stairs, concrete wall patching, painting entire Control Building electrical area and Electrical Room. Provide door between Blower and Control Building Electrical area and finishing performed per the drawings and per the Contract Documents or as otherwise necessary for the completion of the Work associated with this Contract.

Payment for this item shall be lump sum.

6. Bid Item No. 4A – General Electrical Provisions

- a. Miscellaneous Electric shall include all labor, materials, and equipment necessary for site work, temporary power, low voltage cables, conduit, cable tray and supports, pull boxes, ductbanks, handholes, equipment relocation and ancillary items as indicated on the drawings, specified herein or as otherwise necessary for the completion of the Work associated with this Contract.
- b. Temporary Generator Power - **The plant facility cannot be without power (Normal or Standby).** Only short durations for individual equipment can be tolerated and must be coordinated with plant personnel.

Payment for this item shall be Lump Sum

7. Bid Item No. 4B - Panelboards

- a. Shall include all labor, materials, and equipment necessary for site work, demolition, temporary power, terminal lugs, wire markers, panelboards, and ancillary items as indicated on the drawings, specified herein or as otherwise necessary for the completion of the Work associated with this Contract.

Payment for this item shall be each.

8. Bid Item No. 4C – MCC and Service Entrance Main Breaker

- a. Shall include all labor, materials, and equipment necessary for the installation of the MCC and Main Breaker. Work will consist of but not limited to placing the electrical equipment and ancillary items as

indicated on the drawings, specified herein or as otherwise necessary for the completion of the Work associated with this Contract.

Payment for this item shall be each.

9. Bid Item No. 4D – Switchboards SWBRD-1, SWBD-2 and Integrated Power Center
 - a. Shall include all labor, materials, and equipment necessary for the installation of – SWBRD-1, SWBD-2 and Integrated Power Center. Work will consist of but not limited to placing the electrical equipment and ancillary items as indicated on the drawings, specified herein or as otherwise necessary for the completion of the Work associated with this Contract.

Payment for this item shall be each.

10. Bid Item No.4E ASCO Automatic Transfer Switch w/ Bypass
 - a. Shall include all labor, materials, and equipment necessary for the installation of ASCO Automatic Transfer Switch w/ Bypass Work will consist of but not limited to placing the electrical equipment and ancillary items as indicated on the drawings, specified herein or as otherwise necessary for the completion of the Work associated with this Contract.

Payment for this item shall be lump sum.

11. Bid Item No.4F Trystar Load Bank and Portable Generator Docking Station
 - a. Shall include all labor, materials, and equipment necessary for the installation of Trystar Load Bank and Portable Generator Docking Station. Work will consist of but not limited to placing the electrical equipment and ancillary items as indicated on the drawings, specified herein or as otherwise necessary for the completion of the Work associated with this Contract.

Payment for this item shall be lump sum.

12. Bid Item No. 5 – Record Drawings
 - a. Payment for all work included under this Bid Item shall be made at the Contract lump sum price bid listed in the Bid Form and shall represent full compensation for all labor, materials and equipment required to generate and provide record drawings approved and accepted by the City. Record drawings shall be in strict accordance with City of Clearwater Standards.

Payment for this item shall be lump sum.

13. Bid Item No. 6 – Permit Allowance

- a. Fees for submitting applications for permits required to complete construction in accordance with the plans and specifications, such as Building Permit, NPDES, etc. The quantity measured for payment shall be the actual receipt-supported permit fees. Payment will be made at the actual cost to the Contractor for the permits required and acquired. Upon completion of the permitting process, the Contractor will submit receipts for permit fees to the City and Engineer.

Payment for this item shall be lump sum.

14. Bid Item No. 7 - Contingency

- a. Payment for all work under this Bid Item shall be made only at the City's discretion. This Bid Item shall not exceed 5% of the Bidders Total Base Bid. The Bidder shall calculate and enter a dollar amount for this Bid Item.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 25 13 - SUBSTITUTIONS AND PRODUCT OPTIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. General

1. This section covers furnishing of all labor, materials, tools, equipment, and performing all work and services for furnishing, submission, processing and handling of requests for substitution and product options. See items as indicated on drawings and as specified. Any substitution or option shall be in accordance with provisions of Contract Documents, and completely coordinated with work of other trades.
2. Although such work is not specifically indicated, furnish all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
3. See appropriate sections for specific items specified. See General Conditions for additional information.

B. Procedure

1. For equipment and materials which are listed in the proposal, observe procedures outlined in Information for Bidders.
2. For products, equipment, and materials which are named in drawings or specifications for which a request for substitution is made, observe procedures outlined in these specifications.

C. Cost incurred by requester in providing information, catalogs, and samples - including but not limited to labor, materials, freight postage, and transportation - are sole cost of "Requestor" with no cost assessed Owner or Engineer.

D. Although such work is not specifically indicated, furnish all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation.

E. All communication with the City during bidding phase shall be in writing, either by e-mail or fax, and shall be directed to the City's Public Works Department at:

City of Clearwater, Public Works
ATTN: Jennifer Burgett
100 S. Myrtle Avenue, Room 220
Clearwater, FL 33756
E-mail: Jennifer.Burgett@MyClearwater.com

F. All communication with the City during construction shall be through the City's Public Works Department. The City's Project Representative shall be introduced at the pre-construction meeting.

1.02 REQUESTS FOR SUBSTITUTION - GENERAL

- A. Base all bids on materials, equipment and procedures specified.
- B. Certain types of equipment and kinds of material are described in specifications by means of trade names and catalog numbers and/or manufacturer's names. Where this occurs, it was not intended to exclude from consideration such types of equipment and kinds of material bearing other trade names, catalog numbers and/or manufacturer's names, capable of accomplishing purpose of types of equipment or kinds of material specifically indicated, unless specifically noted as such.
- C. Other types of equipment and kinds of material may be acceptable to Owner and Engineer.
- D. Types of equipment, kinds of material and methods of construction, if not specifically indicated must be approved in writing by Engineer and be agreed upon by Owner prior to letting of Contract.
- E. Conditional bids will not be accepted.

1.03 SUBMISSION OF REQUESTS FOR SUBSTITUTION

- A. After the bid date and prior to award of the Contract, the Engineer will consider requests for substitutions of products, materials, systems or other items. Requests must be received by Engineer within ten calendar days after the date of bid opening. All requests for substitution shall be completed as specified below.
- B. Substitute items must comply with color and pattern of base specified items unless specifically approved otherwise.
- C. Submit four (4) copies of request for substitution. Include in request:
 - 1. Name of product located by Drawing No. or Specification No., followed by a detail or line number the particular item(s) for which request for substitution is initiated.
 - 2. Complete data substantiating compliance of proposed substitution with Contract Documents.
 - 3. For products:
 - a. Product identification by schedule or tag no., including manufacturer's name.
 - b. Manufacturer's literature, marked to indicate specific model, type, size, and options to be considered:
 - 1) Product Description.
 - 2) Performance and test data.
 - 3) Reference standards.
 - 4) Difference in power demand.

- 5) Dimensional differences for specified unit.
 - c. Submit samples, full size if so required. Engineer reserves right to impound sample until physical units are installed on project for comparison purposes. All costs of furnishing and return of samples shall be paid by requester. Engineer is not responsible for loss of or damage to samples.
 - d. Name and address of similar projects on which product was used, date of installation, and field performance data on installation.
 4. Itemized comparison of proposed substitution with product, materials, systems or other items specified.
 5. Data relating to changes in construction schedule.
 6. Accurate cost data on proposed substitution in comparison with product, materials, systems or other items specified.
 7. Include with any request a specific statement defining changes in contract time or amount.
- D. In making request for substitution, or in using an approved substitute item, Supplier/Manufacturer represents:
1. He has personally investigated proposed product, materials, systems or other items, and has determined that it is equal or superior in all respects to that specified, and that it will perform function for which it is intended.
 2. Will provide same or better warranty for substitute item as for product, materials, systems or other items specified.
 3. Will coordinate installation of accepted substitution into work, to include but not be limited to the following:
 - a. Building and structure modifications as necessary
 - b. Additional ancillary equipment to accommodate change
 - c. Piping, valving, mechanical, electrical, or instrumentation changes
 - d. All other changes required for work to be complete in all respects to permit incorporation of substitution into project
 4. Waives all claims for additional costs related to substitution, which subsequently become apparent.
- E. Written acceptance or rejection of items presented for alternative consideration will be given within two weeks after request is received.
- G. In the event the acceptance of an alternate results in a change in contract price or time, or is a deviation from the Contract Documents, a change order will be issued to reflect such change. In the event the acceptance of an alternate does not result in a change in Contract price or time, a field order shall be issued.
- H. Rejection of alternates:
1. Acceptance will require substantial revision of Contract Documents or building spaces.

2. If they are in Engineer's opinion, not equal to base product specified, or will not adequately perform function for which intended.
3. If request is not initiated by the Contractor in accordance with this specification section.

1.04 SUBSTITUTION AFTER CONTRACT AWARD

- A. Unavailability of specified item due to strikes, lockouts, bankruptcy, discontinuance of production, proven shortage, or similar occurrences are only reasons for substitution after Contract award.
- B. Notify Owner in writing, as soon as condition of unavailability becomes apparent; include substantiating data. Submit request for substitution sufficiently in advance to avoid delays.
- C. Submit data as required in paragraph 1.3 C above.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 00 - MOBILIZATION

PART 1 - GENERAL

1.01 DEFINITION AND SCOPE

- A. Mobilization shall include, but not be limited to, compliance with the General Conditions outlined in Section III and the following principle items:
1. Indemnification
 2. Preconstruction Conference as specified in Section III Article 2.5.
 3. Notify residences in accordance with Section III Article 22.
 4. Move onto the site all Contractor's plant and equipment required for first month operations.
 5. Install temporary construction power, water supply, wiring, and lighting facilities.
 6. Establish fire protection plan and safety program.
 7. Provide on-site sanitary facilities and potable water facilities as specified.
 8. Arrange for, and erect, Contractor's work and storage yard and employees' parking facilities.
 9. Submit all required insurance certificates and bonds.
 10. Obtain all required permits.
 11. Post all OSHA, Environmental Protection Agency, SWFWMD, Department of Labor, and all other required notices.
 12. Have Contractor's superintendent at the job site full time.
 13. Erect project sign(s) as specified in Section III Article 23.
 14. Submit storm water management/dewatering plan, schedule of values, list of shop drawings, and detailed construction schedule acceptable to Owner.
 15. Provide audio-video recording of existing conditions in accordance with Section IV Article 105.
 16. Demobilization
 17. Submit a finalized schedule of submittals.
 18. Construct, maintain, and/or restore any temporary access and haul roads.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 19 - COORDINATION

PART 1 – GENERAL

1.01 PROJECT COORDINATION

- A. The Contractor shall provide for the complete coordination of the construction efforts. This shall include but not necessarily be limited to coordination of the following:
 - 1. The work of subcontractors.
 - 2. The flow of material and equipment from suppliers.
 - 3. The interrelated work with public and private utility companies.
 - 4. The interrelated work with the Owner where tie-ins to existing facilities are required and where existing equipment must remain in operation.
 - 5. The effort of independent testing agencies.
- B. Work within Pinellas County Right-of-Way shall be in accordance with the Right-of-Way Utilization Permit.
- C. At least one entrance to each property shall be maintained at all times. See Drawings C05 and C08 for additional entrance restrictions.
- D. Contractor shall be responsible for coordinating garbage collection within project limits when construction activities prevent normal access to dumpsters. Contractor shall coordinate with the City of Clearwater and impacted communities to determine acceptable temporary dumpster collection arrangements either via the contractor moving the dumpster to an accessible location during collection day, providing the collection truck with a temporary means of access to the dumpster, temporarily relocating the dumpster, or by other means. Temporary dumpster relocations shall be indicated in the Contractor's traffic control plan.
- E. There shall be no construction work causing service interruptions to utilities customers, unless advance written approval is secured from the affected utility authority.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00 – SHOP DRAWINGS, PROJECT DATA AND SAMPLES

PART 1 – GENERAL

1.1 CONSTRUCTION SCHEDULE

- A. At or before the preconstruction conference, Contractor shall submit for review a preliminary schedule of the proposed construction operations. The construction schedule shall indicate the sequence of the Work, the time of starting and completion of each part, and the installation date for each major item of equipment, and the time for making connections to existing piping, the critical path, structures, or facilities. Within 10 days after receipt of the Owner's comments, the Contractor shall submit an updated Construction Progress Schedule.
- B. An updated schedule shall be submitted with each application for progress payment, or at least every 30 days, to reflect changes in the progress of the work. All schedules shall indicate the critical path.
- C. If the progress of the work falls behind schedule, the Contractor shall submit a report which includes sufficient narrative to describe current and anticipated delaying factors, the factors' effect on the construction schedule and the Contractor's proposed corrective actions. Any work reported complete, but which is not readily apparent to Owner, must be substantiated with satisfactory evidence. The Owner may require the Contractor to add to his equipment, or construction forces, as well as increase the working hours, if operations fall behind schedule at any time during the construction period.

1.2 PROGRESS REPORTS

- A. A progress report shall be furnished to Owner with each application for progress payment. If the Work falls behind schedule, Contractor shall submit additional progress reports at such intervals as Owner may request.
- B. Each progress report shall include sufficient narrative to describe current and anticipated delaying factors, their effect on the construction schedule, and proposed corrective actions. Any Work reported complete, but which is not readily apparent to Owner, must be substantiated with satisfactory evidence.
- C. Each progress report shall also include three prints of the accepted graphic schedule marked to indicate actual progress.

1.3 SCHEDULE OF VALUES

- A. The schedule of values, showing the value of each kind of work, shall be provided by the Owner for use in submitting monthly applications for payments.

- B. The sum of the lump sum items, plus the extended unit price items listed in the schedule of values shall equal the contract price. Such items as Bond premium, temporary construction facilities, may be listed separately in the schedule of values, provided the amounts can be substantiated. Overhead and profit shall not be listed as separate items.
- C. An unbalanced schedule of values providing for overpayment to the Contractor on items of work which would be performed first will not be accepted. The schedule of values shall be revised and resubmitted until acceptable to Owner. Final acceptance by Owner shall indicate only consent to the schedule of values as a basis for preparation of applications for progress payments and shall not constitute an agreement as to the value of each indicated item.

1.4 SCHEDULE OF PAYMENT

- A. Within 30 days after award of contract, the Contractor shall furnish to Owner a schedule of estimated monthly payments. The schedule shall be revised and resubmitted each time an application for payment varies more than 10 percent from the estimated payment schedule.

1.5 SURVEY DATA

- B. All field books, notes, and other data developed by the Contractor in performing surveys required as part of the work shall be available to Owner for examination throughout the construction period. All such data shall be submitted to Owner with the other documentation required for final acceptance of the Work.

1.6 SHOP DRAWINGS AND ENGINEERING DATA

- A. Engineering data covering all equipment and fabricated materials that will become a permanent part of the work under this Contract shall be submitted to Owner, or the Owner's representative, for review. These data shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorages, and supports required; performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.
- B. All submittals regardless of origin, shall be reviewed, dated, stamped, approved, sealed (if required) and signed by the Contractor prior to submission. Each submittal shall be identified with the name and number of this Contract, the Contractor's name, and references to applicable specification paragraphs and/or Contract Drawings. Each submittal shall indicate the intended use of the item in the work. When catalog pages are submitted, applicable items shall be clearly identified. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.
- C. Contractor's stamp of approval is a representation to the Owner and the Engineer that the Contractor accepts full responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers,

and similar data, and that he has reviewed and coordinated each submittal with the requirements of the work and the Contract Documents.

- D. All deviations from the Contract Documents shall be identified on each submittal and shall be tabulated in Contractor's letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by the Contractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.
- E. The Contractor shall accept full responsibility for the completeness of each submission, and, in the case of a resubmission, shall verify that all exceptions previously noted by the Owner and/or the Engineer have been addressed. In the event that more than one resubmission is required because of failure of Contractor to account for exceptions previously noted, the Contractor shall reimburse the Owner for the charges of the Engineer for review of the additional resubmissions.
- F. Resubmittals shall be made within 30 days of the date of the letter returning the material to be modified or corrected, unless within 14 days the Contractor submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time.
- G. Any need for more than one resubmission, or any other delay in obtaining the Owner's and/or the Engineer's review of submittals, will not entitle Contractor to extension of the Contract Time unless delay of the Work is directly caused by a change in the work authorized by a Change Order or by failure of the Engineer to return any submittal within 14 days after its receipt in Engineer's office.
- H. The Contractor's letter of resubmittal shall list the date of his original submittal letter, the date of the Engineer's letter returning the submittal, and the dates of submission and return of any previous resubmittals.
 - I. The Engineer's review of drawings and data submitted by the Contractor will cover only general conformity to the drawings and specifications. The Engineer's review does not indicate a thorough review of all dimensions, quantities, and details of the material, equipment, device or item shown. The Engineer's review of submittals shall not relieve the Contractor from responsibility for errors, omissions, or deviations, nor responsibility for compliance with the Contract Documents.
 - J. Submittals shall be submitted for review electronically via PDF documents to the Owner and the Engineer. A document control distribution list will be determined at the preconstruction meeting. Engineer will not accept submittals from anyone but Contractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.), to indicate the sequence of the resubmittal.
 - K. When the drawings and data are returned marked AMEND AND RESUBMIT or REJECTED, the corrections shall be made as noted thereon and as instructed by

the Engineer and submitted for review electronically via PDF documents to the Owner and the Engineer.

- L. When corrected copies are resubmitted, Contractor shall in writing direct specific attention to all revisions and shall list separately any revisions made other than those called for by Engineer on previous submissions.
- M. When the drawings and data are returned marked NO EXCEPTIONS TAKEN, or MAKE CORRECTIONS NOTED, no additional copies need be furnished.

1.7 MANUFACTURER'S REPRESENTATIVE

- A. Included in Bid shall be the cost of furnishing competent and experienced manufacturer's representatives who shall represent the manufacturer on products furnished, assist the Contractor to install products in conformity with the Contract Documents, and provide owner training and maintenance instruction.

1.8 LAYOUT DATA

- A. Contractor shall keep neat and legible notes of measurements and calculations made by him in connection with the layout of the Work. Copies of such data shall be furnished to the Owner's Project Representative for use in checking
- B. Contractor's layout as provided under Lines and Grades. All such data considered of value to Owner will be transmitted to Owner by Engineer with other records upon completion of the Work.

1.9 SUBMITTAL AND RFI LOGS

- A. Contractor will be responsible for the preparation of Submittal and RFI Logs. These logs are due no later than two (2) weeks from the Preconstruction Conference and are to be updated and brought to each Progress Meeting. The Submittal log should be a complete list of all proposed submittals required for the project. The RFI log will serve to ensure timely response to all Requests for Information.

1.10 SUBMITTALS FOR COLOR SELECTION

- A. The following is a list of items which must be submitted together for color selection. No single item on this list will be approved without the submittal of all other items.
 - 1. Exterior package: Paint for aboveground piping, valves, valve box covers, meter box covers, etc.

PART 2 – PRODUCTS (NOT USED)
PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 40 00 - QUALITY CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Quality assurance and control of installation.
- B. References.
- C. Field samples.
- D. Mock-up.
- E. Inspection and testing laboratory services.
- F. Manufacturers' field services and reports.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Shop Drawings, Project Data and Samples
- B. Section 01 45 29 – Testing Laboratory Services.

1.03 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply fully with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship of specified quality.
- F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.04 REFERENCES

- A. Conform to reference standard by date of issue current on date of Owner Bids.

- B. Should specified reference standards conflict with Contract Documents, request clarification from Owner's Project Representative before proceeding.
- C. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.05 FIELD SAMPLES

- A. Install field samples at the site as required by individual specifications Sections for review.
- B. Acceptable samples represent a quality level for the Work.
- C. Where field sample is specified in individual Sections to be removed, clear area after field sample has been accepted by Owner's Project Representative.

1.06 MOCK-UP

- A. Tests will be performed under provisions identified in this section.
- B. Assemble and erect specified items, with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Where mock-up is specified in individual Sections to be removed, clear area after mock-up has been accepted by Owner's Project Representative.

1.07 INSPECTION AND TESTING LABORATORY SERVICES

- A. Contractor will appoint, employ, and pay for services of an independent firm to perform inspection and testing.
- B. The independent firm will perform inspections, tests, and other services specified in individual specification Sections and as required by the Owner.
- C. Reports will be submitted by the independent firm to the Owner, Contractor, and the Engineer, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- D. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
 - 1. Notify Owner and independent firm 24 hours prior to expected time for operations requiring services.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- E. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Owner. Payment for retesting will be charged to the Contractor.

1.08 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. Submit qualifications of observer to Owner's Project Representative 30 days in advance of required observations. Observer subject to approval of Owner.
- B. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance of equipment as applicable, and to initiate instructions when necessary.
- C. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Submit report in duplicate within 30 days of observation to Owner's Project Representative for review.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 29 - TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Selection and payment.
- B. Laboratory responsibilities.
- C. Laboratory reports.
- D. Limits on testing laboratory authority.
- E. Contractor responsibilities.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Shop Drawings, Project Data and Samples
- B. Individual Specification Sections: Inspections and tests required, and standards for testing.

1.03 REFERENCES

- A. ANSI/ASTM D3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- B. ANSI/ASTM E329 - Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

1.04 SELECTION AND PAYMENT

- A. The Contractor shall employ and pay for services of an independent testing laboratory to perform specified inspection and testing.
- B. Employment of testing laboratory shall in no way relieve Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of ANSI/ASTM E329 and ANSI/ASTM D3740.
- B. Laboratory: Authorized to operate in the state in which Project is located.
- C. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.

- D. Submittals: The contractor shall submit the name, address and qualifications of selected laboratory for Owner's approval prior to application for first payment.
- E. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to either National Bureau of Standards (NBS) Standards or accepted values of natural physical constants.

1.06 LABORATORY RESPONSIBILITIES

- A. Test samples of mixes submitted by Contractor.
- B. Provide qualified personnel at site. Cooperate with Owner and Contractor in performance of services.
- C. Perform specified inspection, sampling, and testing of Products in accordance with specified standards.
- D. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- E. Promptly notify Owner and Contractor of observed irregularities or non-conformance of Work or Products.
- F. Perform additional inspections and tests required by Owner's Project Representative.

1.07 LABORATORY REPORTS

- A. After each inspection and test, promptly submit two copies of laboratory report to Owner and to Contractor.
- B. Include:
 - 1. Date issued,
 - 2. Project title and number,
 - 3. Name of inspector,
 - 4. Date and time of sampling or inspection,
 - 5. Identification of product and Specifications Section,
 - 6. Location in the Project,
 - 7. Type of inspection or test,
 - 8. Date of test,
 - 9. Results of tests,
 - 10. Conformance with Contract Documents.
- C. When requested by Owner, provide interpretation of test results.

1.08 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.

- B. Laboratory may not approve or accept any portion of the Work.
- C. Laboratory may not assume any duties of the Contractor.
- D. Laboratory has no authority to stop the Work.

1.09 CONTRACTOR RESPONSIBILITIES

- A. Cooperate with laboratory personnel, and provide access to the Work and to manufacturer's facilities.
- B. Provide incidental labor and facilities to provide access to Work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, storage and curing of test samples.
- C. Notify Owner and laboratory 24 hours prior to expected time for operations requiring inspection and testing services.
- D. Employ services of a separate qualified testing laboratory and pay for additional samples and tests required by Contractor beyond specified requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES

PART 1 – GENERAL

1.01 SANITARY FACILITIES

- A. The Contractor shall provide and maintain sanitary accommodations (to include portable toilets) for employees and official site visitors, to comply with the requirements and regulations of the State of Florida, the County Health Department and/or other regulatory agencies.
- B. Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view to the greatest practical extent. If toilets of the chemically treated type are used, at least one toilet will be furnished for each 20 men. Contractor shall enforce the use of such sanitary facilities by all personnel at the site.

1.02 BARRICADES AND LIGHTS

- A. All streets, roads, highways, and other public thoroughfares which are closed to traffic shall be protected by effective barricades on which shall be placed acceptable warning signs. Barricades shall be located at the nearest intersecting public highway or street on each side of the blocked section.
- B. All open trenches and other excavations shall have suitable barricades, signs, and lights to provide adequate protection to the public. Obstructions such as material piles and equipment shall be provided with similar warning signs and lights. Contractor shall be responsible for public safety within the construction area.
- C. All barricades and obstructions shall be illuminated with warning lights from sunset to sunrise. Material storage and conduct of the Work on or alongside public streets and highways shall cause the minimum obstruction and inconvenience to the traveling public. All barricades, signs, lights and other protective devices shall be installed and maintained in conformity with applicable statutory requirements and, where within railroad and highway rights-of-way, as required by the authority having jurisdiction thereover.
- D. Open trenches and other excavations shall not be left open over weekends and holidays, or greater than one calendar day, except during adverse weather conditions.

1.03 PROTECTION OF PUBLIC AND PRIVATE PROPERTY

- A. Contractor shall protect, shore, brace, support, and maintain all underground pipes, conduits, drains, and other underground construction uncovered or

otherwise affected by his construction operations. All pavement, surfacing, driveways, curbs, walks, buildings, utility poles, guy wires, fences, and other surface structures affected by construction operations, together with all sod and shrubs in yards and parkings, shall be restored to their original condition, whether within or outside the easement. All replacements shall be made with new materials.

1.04 PARKING

- A. Contractor shall provide and maintain suitable parking areas for the use of all construction workers and others performing work or furnishing services in connection with the Project, as required to avoid any need for parking personal vehicles where they may interfere with public traffic, Owner's operations, or construction activities.

1.05 DUST CONTROL

- A. Contractor shall take reasonable measures to prevent unnecessary dust. Earth surfaces subject to dusting shall be kept moist with water. Dusty materials in piles or in transit shall be covered when practicable to prevent blowing.
- B. Buildings or operating facilities which may be affected adversely by dust shall be adequately protected from dust. Existing or new machinery, motors, instrument panels or similar equipment, shall be protected by suitable dust screens. Proper ventilation shall be included with dust screens.
- C. Contractor shall employ best management practices as specified in Section IV Article 207.

1.06 SWEEPING

- A. The Contractor shall sweep/clean all roadways, driveways, sidewalks, etc. within the work area at the end of each workday.

1.07 POLLUTION CONTROL

- A. Contractor shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris and other substances resulting from construction activities. No sanitary wastes will be permitted to enter any drain or watercourse other than sanitary sewers. No sediment, debris or other substance will be permitted to enter sanitary sewers and reasonable measures will be taken to prevent such materials from entering any drain or watercourse.

1.08 PROJECT SIGN

- A. Provide sign(s) for the Contract identifying the project and identifying the participants in the development of the project The Project Sign shall be provided and erected in accordance with Section III Article 23.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 71 23 - FIELD ENGINEERING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The Contractor shall provide and pay for field engineering service required for the project. Such work shall include survey work to establish lines and grades and to locate and lay out site improvements, structures, and controlling lines and levels required for the construction of the work. Also included are such Engineering services as are specified or required to execute the Contractor's construction methods. Engineers and Surveyors shall be licensed professionals under the laws of the state where the project is located.

1.02 GRADES, LINES AND LEVELS

- A. Existing basic horizontal and vertical control points for the project are those designated on the Drawings. The Contractor shall locate and protect control points prior to starting site work and shall preserve all permanent reference points during construction. In working near any permanent property corners or reference markers, the Contractor shall use care not to remove or disturb any such markers. Survey monuments, benchmarks or other reference points, which must be disturbed by construction operations, shall be witnessed, removed and replaced by a Professional Surveyor and Mapper (PSM), registered in the State of Florida.
- B. Basic horizontal and vertical control points are indicated on the plans. These points shall be used as datum for the Work. All additional survey, layout, and measurement Work shall be performed by Contractor as a part of the Work. The contractor shall provide, install and maintain construction stakes for grades and measurements necessary for execution and control of the work.
- C. Contractor shall provide an experienced instrument man, competent assistants, and such instruments, tools, stakes, and other materials required to complete the survey, layout and measurement Work. In addition, Contractor shall furnish, without charge, competent men from his force and such tools, stakes, and other materials as Owner may require in establishing or designating control points, or in checking survey, layout, and measurement Work performed by Contractor. Surveyors shall be licensed professionals under the laws of the state where the project is located.

1.03 LAYOUT DATA

- A. The Contractor shall layout the work at the location and to the lines and grades shown on the Drawings. Survey notes indicating the information and measurements used in establishing locations and grades shall be kept in notebooks and furnished to the Owner with the as-builts for the project.

1.04 EXISTING STRUCTURES

- A. The locations for existing underground piping and structures shown on the Drawings were taken from the available records. The actual locations of the existing underground piping and structures may differ from that shown on the Drawings.
- B. The Drawings may not show existing underground electrical conduits, small piping, or other piping and structures. Prior to starting excavations for structures or the installation of underground piping, conduits, and other facilities the Contractor shall thoroughly examine the proposed locations and routes for possible conflict.
- C. The Contractor shall excavate and expose all existing underground piping, conduit, or other structures which may conflict with the new facilities or other improvements. The locations, both horizontally and vertically, of all such existing facilities shall be shown on the as-builts.
- D. After completion of the subsurface investigations the Contractor shall notify the Owner of any possible conflicts between the existing and new facilities. The Contractor, Owner, and the Engineer will then confer and resolve the potential conflicts prior to the start of the installation of the new facilities.

1.05 AS-BUILTS

- A. The Contractor shall keep one set of Drawings, Specifications, Addenda, Modifications and Shop Drawings at the site in good order, and annotated to show all changes made during the construction process. As-Builts shall be up-to-date as the project progresses, will be subject to review on a monthly basis by the Owner, and, subject to the review, be a basis for monthly payments.
- B. These documents shall be available at any time to the Owner and, together with copies of all survey notes, be delivered in final form to the Owner upon completion of the project.
- C. The location, both horizontally and vertically, of all underground piping, conduit, and other structures shall be shown on the as-builts. All fittings, valves, and other appurtenances shall be located and shown on the as-builts in accordance with Section 6.11.2 "As-Built Drawings" in the General Conditions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This Section establishes general requirements pertaining to cutting (including excavating), fitting, and patching of the Work required to:
- B. Make the parts fit properly.
- C. Remove and replace Work not conforming to requirements of the Contact Documents.
- D. Rework existing items to provide for new construction.

1.02 QUALITY ASSURANCE

- A. Perform all cutting and patching in strict accordance with pertinent requirements of these Specifications and, in the event no such requirements are determined, in conformance with the Engineer's written direction.
- B. Codes and standards for work of this section shall be the same as for the pertinent sections of this specification.

1.03 SUBMITTALS

- A. Request for Engineer's Consent:
 - 1. Prior to cutting which affects structural safety, submit written request to the Engineer for permission to proceed with cutting.
 - 2. Should conditions of the Work, or schedule, indicate a required change of materials or methods for cutting and patching, so notify the Engineer and secure his written permission prior to proceeding.
- B. Notice to the Engineer: Submit written notice to the Engineer designating time the Work will be uncovered, to provide for the Engineer's observation.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials used in the replacement of existing work and the construction of work in conjunction with cutting and patching shall be new unless prior approval from the Engineer has been obtained to re-use existing materials.

2.02 FABRICATION

- A. The materials and methods used in the fabrication of items required under this section shall comply with the individual sections of this specification that have to do with new construction.

PART 3 - EXECUTION

3.01 CONDITIONS

- A. Examination:
 - 1. Examine existing conditions, including elements subject to movement or damage during cutting, excavating, backfilling, and patching.
 - 2. After uncovering the Work, inspect conditions affecting installation of the new Work.
- B. Discrepancies:
 - 1. If uncovered conditions are not as anticipated, immediately notify the Engineer and secure needed directions.
 - 2. Do not proceed in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 PREPARATION PRIOR TO CUTTING

- A. Provide all required protection including, but not necessarily limited to, shoring, bracing, and support to maintain structural integrity of the Work.

3.03 PERFORMANCE

- A. Perform all required excavating and backfilling as required under pertinent Sections of these Specifications. Perform cutting and demolition by methods which will prevent damage to other portions of the Work and will provide proper surfaces to receive installation of repair and new work. Perform fitting and adjustment of products to provide finished installation complying with the specified tolerances and finishes.

END OF SECTION

SECTION 01 77 00 - CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Final cleaning
- B. Adjusting
- C. Project record documents
- D. Warranties

1.02 FINAL CLEANING

- A. Execute final cleaning prior to final inspection.
- B. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.03 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.04 WARRANTIES

- A. Provide duplicate notarized copies of all applicable warranties and guarantees.
- B. Execute and assemble documents from Subcontractors, suppliers, and manufacturers.
- C. Provide Table of Contents and assemble in three D side ring binder with durable plastic cloth cover.
- D. Submit prior to final Application for Payment.
- E. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.05 PROJECT RECORD DOCUMENTS

- A. Record information concurrent with construction progress as indicated in specifications. See Section III Article 6.11.2 for As-Built requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 02 41 00 DEMOLITION

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. This section includes demolition, debris removal, items to be abandoned in place and items to be salvaged as indicated on the Drawings and as specified herein.
- B. Demolition items may include, but may not be limited to the following:
 - 1. Existing Equipment (includes wire, conduit, and piping)
 - 2. Existing concrete wall between Maintenance and Control Building Electrical Room.
 - 3. Concrete wall for Doorway between Control Building Electrical Room and Blower Room
 - 4. Blower and Electrical Room Slabs, Plenum Area, Plenum Air Intake Structure
 - 5. Plenum equipment, piping, and platform
 - 6. MCC-1, FRP Building, slab, anoxic mixer conduit
 - 7. All other items or areas required, whether or not shown on the Drawings or specified herein.
- C. Items to be salvaged and re-used as part of the project.
- D. Items to be salvaged and returned to the Owner include
 - 1. ASCO ATS Switch- Return to Owner
- E. Additional items to be salvaged may be identified during the preconstruction meeting.

1.02 QUALITY ASSURANCE

- A. Accomplish all demolition work so there is no injury to any persons and no damage to adjacent structures or property. All demolition methods shall be in full compliance with municipal, City, state, and federal ordinances. Demolition work shall comply with the requirements of the Occupational Safety and Health Administration (OSHA).
- B. The Contractor shall comply with all municipal, City, state and federal ordinances regarding the disposal of rubble, scrap metal, and refuse.
- C. Demolition procedures shall provide for safe conduct of the work, protection of property which is to remain undisturbed, and coordination with other work in progress.

1.03 JOB CONDITIONS

- A. It shall be the responsibility of the Contractor to visit the site and inspect the nature and condition of the items to be removed and salvaged before submitting his bid.
- B. Dust Control: Control the amount of dust resulting from demolition to prevent the spread of dust to occupied portions of buildings and to avoid creation of a nuisance in the surrounding area. Do not use water when it will result in, or create, hazardous or objectionable conditions such as flooding and pollution.
- C. Protection of Existing Work: Protect existing work. Work damaged by the Contractor shall be repaired to match existing work.
- D. No interference with plant operations: Demolition work shall be scheduled and conducted so there is no interference with normal plant operations or deliveries.

PART 2 PRODUCTS

2.01 REPAIR AND REPLACEMENT MATERIALS

- A. Materials used in the repair or replacement of existing work to remain shall be the higher cost of: 1) Materials specified or shown in the Contract Documents; or 2) items identical or equal to the materials used in existing work when new.

2.02 PIPE ABANDONMENT GROUT

- A. Pipe abandonment grout shall conform to the “Non-Excavatable” flowable fill described in FDOT Specification Section 121.

PART 3 EXECUTION

3.01 STRUCTURES AND BUILDINGS

- A. Remove all parts of existing structures to be demolished to a minimum depth of 3-ft below grade unless otherwise shown on the drawings. Structures left below grade shall be punctured to allow water to pass through and prevent flotation.

3.02 EQUIPMENT

- A. Completely remove equipment which is designated to be removed.
- B. Remove concrete equipment bases if the existing bases are not to be used for new equipment.

- C. Completely remove isolated equipment bases.

3.03 PIPING

- A. Completely remove piping, conduit, and wiring in structures and buildings which are to be demolished, partially demolished, and where otherwise designated to be removed as shown on the Drawings. When not indicated on the Drawings, the removal of said piping, conduit and wiring shall be a minimum of 5-feet from the

outside of the structure or building. The Contractor shall schedule underground pipe removal and new pipe installation in order to minimize disruption of the existing piping system and reduce bypass pumping.

- B. Underground piping, conduit, and wiring which are to be abandoned and do not interfere with new work may be left in place, unless otherwise shown on the Drawings. Plug and seal ends of underground piping to be abandoned. Grout fill abandoned pipes in accordance with plans. Do not leave abandoned branches of piping and wiring "live". Isolate abandoned branches by closing branch valve at main or by disconnecting branch at main. Plug, cap, and seal active branch at isolating valve or point of disconnection.
- C. Properly disconnect, seal and plug utility services to structures and buildings which are completely demolished. Properly disconnect, seal, and plug utility lines within structures and buildings which are partially demolished.

3.04 DISPOSAL

- A. Equipment, piping, and materials which are designated to remain the property of the Owner shall be moved to a location within the project site designated by the Owner.
- B. All removed equipment, piping, and materials not specifically designated to remain the property of the Owner shall become the property of the Contractor and shall be removed from the site and properly disposed of.
- C. Do not allow debris and rubbish to accumulate on the site. Remove debris and rubbish from the site.
- D. If the Contractor is responsible for disposal and fees.

3.05 FILLING

- A. Backfill excavations resulting from demolition.
- B. Backfill excavations which will not be beneath new structures, buildings, piping, or other new work as specified in this paragraph.
- C. Backfill excavations shall be in accordance with the Contract Documents.
- D. Place and compact backfill in other excavations to produce an adequate foundation for grassing.

3.06 CLEAN-UP

- A. Clean-up in areas where other work is to be done following demolition shall be as specified in the applicable Sections.

- B. Clean-up the job site in areas where no other work is to be done under this Contract following demolition. Remove all debris and rubbish, temporary facilities, and equipment. Level surface irregularities to eliminate depressions. Leave the work in a neat and presentable condition.

END OF SECTION

SECTION 03 30 00 CAST IN PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Code references
 - 1. Florida Building Code (FBC) 2020 Edition.
 - 2. ACI 301, "Structural Concrete for Buildings."
 - 3. ACI 318, "Building Code Requirements for Reinforced Concrete."
 - 4. ACI 350, "Code Requirements for Environmental Engineering Concrete Structures"

1.02 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Minor equipment pads and pipe encasements.
 - 2. Structural Concrete – All other concrete.
- B. Related Sections:
 - 1. Division 07 – Thermal and Moisture Protection
 - 2. Division 09 – Painting and Coatings

1.03 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Submittals:

1. Design Mixtures: Submit concrete mixture proportions, characteristics and location for use for each concrete mixture. Submittal shall include documentation indicating the proposed concrete proportions will produce an average compressive strength equal to or greater than the required average compressive strength, and shall consist of field strength records (field test data) or trial mixtures in accordance with ACI 301, 4.2.3.4.a or 4.2.3.4.b, respectively. Submit alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
 2. Indicate amounts of mixing water to be withheld for later addition at Project site.
- B. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Location of construction joints is subject to approval of the Engineer.
- F. Samples: None.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, manufacturer and testing agency.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
 2. Admixtures.
 3. Form materials and form-release agents.
 4. Steel reinforcement and accessories.
 5. Waterstops.
 6. Curing compounds.

7. Floor and slab treatments.
 8. Bonding agents.
 9. Adhesives.
 10. Vapor retarders.
 11. Semi rigid joint filler.
 12. Joint-filler strips.
 13. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of pre-installation conference.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete."
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 3. ACI 318, "Building Code Requirements for Reinforced Concrete."
 4. ACI 350, "Environmental Engineering Concrete Structures."
 5. ACI 305, "Hot Weather Concreting."
 6. ACI 306, "Cold Weather Concreting."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Mockups: None.
- I. Pre-installation Conference: Conduct conference at Project site.
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.
 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi rigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement, if applicable.
- B. Waterstops: Store water stops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties for liquid containment structures that have an integral water stop that is tightly welded to the tie.
 - 4. Furnish ties for exposed concrete that are the cone-washer type. The cones shall be made of approved wood or plastic. Common wire will not be allowed for form ties

2.02 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- C. Low-Alloy-Steel Reinforcing Bars: None.
- D. Galvanized Reinforcing Bars: None.
- E. Epoxy-Coated Reinforcing Bars: None.
- F. Stainless-Steel Reinforcing Bars: None.
- G. Steel Bar Mats: None.
- H. Plain-Steel Wire: ASTM A 82/A 82M. None.
- I. Deformed-Steel Wire: ASTM A 496/A 496M.
- J. Epoxy-Coated Wire: None.

- K. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- L. Deformed-Steel Welded Wire Reinforcement: None.
- M. Galvanized-Steel Welded Wire Reinforcement: None.
- N. Epoxy-Coated Welded Wire Reinforcement: None.

2.03 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel deformed bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.04 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type II, gray, no substituted are allowed. Cement replacement by weight can be up 20% of the total weight, replace with Fly Ash and/or Slag.
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Slag: ASTM 989, Grade 120
- B. Normal-Weight Aggregates: ASTM C 33, Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement. Use Clean, sharp, natural silica sand free of loam, clay, lumps, and other deleterious substances. Dune sand, bank run sand, and manufactured sand are not acceptable.

2. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter. Coarse aggregate shall comply with the following:
 - a. Crushed stone, processed from natural rock or stone.
 - b. Washed gravel, either natural or crushed. Slag, pit gravel, and bank-run gravel are not allowed.
 - c. Coarse Aggregate Size: ASTM C33/C33M, No. 57 stone, unless otherwise approved by ENGINEER.
- C. Water: ASTM C 94/C 94M and potable.

2.05 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.06 WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricated corners, intersections, and directional changes.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BoMetals, Inc.
 - b. Greenstreak.
 - c. Vinylex Corp.
 2. Profile: Ribbed with center bulb.

3. Dimensions: 6 inches by 3/8 inch thick or 9 inches by 3/8 inch thick; nontapered.
- B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Adeka Ultra Seal/OCM, Inc.; Adeka Ultra Seal.
 - b. Greenstreak; Hydrotite.
 - c. Vinylex Corp.; Swellseal.
 - d. Sika; Sika Swell S-2.
- C. Self-sealing, non-swelling preformed joint sealant Waterstop: Shall provide a lasting, watertight bond on both fresh and cured concrete surfaces.
1. Products: Henry Company; Synko-Flex Waterstop.

2.07 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class C. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fortifiber Building Systems Group; Moistop Plus.
 - b. Raven Industries Inc.; Vapor Block 6.
 - c. Reef Industries, Inc.; Griffolyn Type-65 or Type-85.
 - d. Stego Industries, LLC; Stego Wrap, 10 mil Class C.
- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

2.08 LIQUID FLOOR TREATMENTS

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ChemMasters; Chemisil Plus.
 - b. ChemTec Int'l; ChemTec One.
 - c. Conspec by Dayton Superior; Intraseal.
 - d. Curecrete Distribution Inc.; Ashford Formula.
 - e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
 - f. Edoco by Dayton Superior; Titan Hard.
 - g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.

- C. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Floor Products; Retro-Plate 99.
 - b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
 - c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.

2.09 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating. Allowed for non-liquid containment structures.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Kure 200.
 - b. ChemMasters; Safe-Cure Clear.
 - c. Conspec by Dayton Superior; W.B. Resin Cure.

- d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
- e. Edoco by Dayton Superior; Res X Cure WB.
- f. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
- g. L&M Construction Chemicals, Inc.; L&M Cure R.
- h. Meadows, W. R., Inc.; 1100-CLEAR.
- i. SpecChem, LLC; Spec Rez Clear.
- j. Symons by Dayton Superior; Resi-Chem Clear.

2.10 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: Provide preformed expansion joint filler complying with ASTM D 1752, Type I (spong rubber) or Type II (cork).
- B. Semi rigid Joint Filler: Two-component, semi rigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types I and II, non-load bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.022 thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.11 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4500 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 4500 psi at 28 days when tested according to ASTM C 109/C 109M.

2.12 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301. Reference Section 1.04.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Use fly ash and/or slag as needed to reduce the total amount of portland cement, which would otherwise be used. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash only: 20 percent by weight.
 2. Slag only: 20 percent by weight.
 3. Fly Ash + Slag: 20 percent by weight.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Color Pigment: If required by Architectural contract drawings, add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.13 CONCRETE MIXTURES

- A. Minor equipment pads and pipe encasements:
1. Minimum Compressive Strength: 3000 psi at 28 days.
 2. Concrete mixture proportions in accordance with accepted design mixes. Reference Section 1.04.
- B. Structural Concrete:
1. Minimum Compressive Strength: Reference Design Criteria Sheet S0.0.
 2. Concrete mixture proportions in accordance with accepted design mixes. Reference Section 1.04.

2.14 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.15 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.03 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 75 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.04 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturers recommended tape.
- B. Bituminous Vapor Retarders: if applicable.

3.05 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.06 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8 inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 07 90 00 " Sealants and Caulking," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.07 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed water stops during progress of the Work. Field fabricate joints in water stops according to manufacturer's written instructions.

- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.08 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.09 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
1. Apply scratch finish to surfaces indicated and to receive mortar setting beds for bonded cementitious floor finishes.

- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Re-straighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces to receive trowel finish.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 - b. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 - c. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
 - d. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.
 3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft. long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
 4. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 5. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 12-inch centers around the full perimeter of concrete base.
 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
 4. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24

hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semi rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.15 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.
 - 3. Headed bolts and studs.
 - 4. Verification of use of required design mixture.
 - 5. Concrete placement, including conveying and depositing.
 - 6. Curing procedures and maintenance of curing temperature.
 - 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
 - 8. Water levels for hydraulic structures.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.

5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.

13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

3.16 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION

SECTION 03 30 10 ANCHOR SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install anchor systems.
2. This Section includes all anchor systems required for the Work, but not specified under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before anchor systems Work.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. ACI 318, Building Code Requirements for Structural Concrete.
2. ANSI B212.15, Cutting Tools - Carbide-tipped Masonry Drills And Blanks For Carbide-tipped Masonry Drills.
3. ANSI/MSS SP-58, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
4. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
5. ASTM A276, Specification for Stainless Steel Bars and Shapes.
6. ASTM A493, Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
7. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
10. ASTM A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
11. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
12. ASTM C307, Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
13. ASTM C881/C881M, Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
14. ASTM 0695, Test Method for Compressive Properties of Rigid Plastics.
15. ASTM 0790, Test Methods for Flexural Properties of Unreinforced and reinforced Plastics and Electrical Insulating Materials.

16. ASTM E329, Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
17. ASTM E488, Test Methods for Strength of Anchors in Concrete and Masonry Elements.
18. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
19. ASTM F594, Specification for Stainless Steel Bolts, Hex Cap Screws, and studs.
20. ASTM F1554, Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
21. ICC-ES AC58, Acceptance Criteria for Adhesive Anchors in Masonry Elements.
22. ICC-ES AC60, Acceptance Criteria for Anchors in Unreinforced Masonry Elements.
23. ICC-ES AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
24. ISO 3506-1, Mechanical Properties of Corrosion-Resistant Stainless Steel Fasteners -- Part 1: Bolts, Screws and Studs.
25. NSF/ANSI 61, Drinking Water System Components- Health Effects.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Testing Laboratory: Shall comply with ASTM E329 and shall be experienced in tension testing of post-installed anchoring systems.
2. Post-installed Anchor Installer: Shall be experienced and trained by post-installed anchor system manufacturer in proper installation of manufacturer's products. Product installation training by distributors or manufacturer's representatives is unacceptable unless the person furnishing the training is qualified as a trainer by the anchor manufacturer.

1.04 SUBMITTALS

A. In accordance with Division 1 requirements, submit the following:

1. Shop Drawings:
 - a. Listing of all anchor systems products intended for use in the Work including product type, intended location in the Project, and embedded lengths.
2. Product Data:
 - a. Manufacturer's specifications, load tables, dimension diagrams, acceptable base material conditions, acceptable drilling methods, and acceptable bored hole conditions.

- b. When required by ENGINEER, copies of valid ICC ES reports that presents load-carrying capacities and installation requirements for anchor systems.
- c. Post installed anchors shall be epoxy adhesive type. Mechanical wedge type anchors are not allowed.

B. Informational Submittals: Submit the following:

1. Certificates:

- a. For each type of anchor bolt or threaded rod, submit copies of laboratory test reports and other data required to demonstrate compliance with the Contract Documents.
 - 1) Reports shall demonstrate compliance with ductile steel element definition of ACI 350, Appendix D, Section D.1.
- b. Post-installed anchor system manufacturer's certification that installer received training in the proper installation of manufacturer's products required for the Work.
- c. For each adhesive anchor installer, submit ACI/CRSI Adhesive Anchor Installer Certification.

2. Manufacturer's Instructions:

- a. Installation instructions for each anchor system product proposed for use, including bore hole cleaning procedures and adhesive injection, cure and gel time tables, and temperature ranges (storage, installation and in-service).

1.05 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:

- 1. Keep materials dry during delivery and storage.
- 2. Store adhesive materials within manufacturer's recommended storage temperature range.
- 3. Protect anchor systems from damage at the Site. Protect products from corrosion and deterioration.

PART 2 – PRODUCTS

2.01 SYSTEM PERFORMANCE

A. General:

- 1. At all locations, provide stainless steel type 316 anchor systems.
- 2. Stainless Steel Nuts:

- a. For anchor bolts and adhesive anchors, provide ASTM A194/A194M, Grade SS stainless steel nuts for stainless steel anchors used for anchoring equipment, gates, and weirs, and other locations, if any, where the attachment will require future removal for operation or maintenance. Provide lock washer or double nuts on each anchorage device provided for equipment, as required by equipment manufacturer.
3. Materials that can contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

B. Design Criteria

1. Size, Length, and Load-carrying Capacity: Comply with the Contract Documents. When size, length or load-carrying capacity of anchor system is not otherwise shown or indicated, provide the following:
 - a. Anchor Bolts: Provide size, length, and capacity required to carry design load based on values and requirements of Paragraph 3.2.A of this Section. For conditions outside limits of critical edge distance and spacing in Paragraph 3.2.A of this Section, minimum anchor bolt embedment as shown or indicated in Paragraph 3.2.A of this Section apply and capacity shall be based on requirements of Laws and Regulations, including applicable building codes.
 - b. Adhesive Anchors and Concrete Inserts: Provide size, length, type, and capacity required to carry design load. Anchor capacity shall be based on the procedures required by the building code in effect at the Site. Where Evaluation Service Reports issued by the ICC Evaluation Service are required in this Section, anchor capacities shall be based on design procedure required in the applicable ICC Evaluation Service Report.
 - 1) General: Determine capacity considering reductions due to installation and inspection procedures, embedment length, strength of base fastening materials, spacing, and edge distance, as indicated in the manufacturer's design guidelines. For capacity determination, concrete shall be assumed to be in the cracked condition, unless calculations demonstrate that the anchor system will be installed in an area that is not expected to crack under any and all conditions of design loading.
 - 2) Concrete Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth, edge distance and spacing as recommended by the manufacturer.
 - 3) Concrete Masonry Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and

edge distance as indicated in anchor manufacturer's instructions.

2. Design Loads. Comply with the Contract Documents. When design load of supported material, equipment, or system is not otherwise shown or indicated, provide the following:
 - a. Equipment Anchors: Use design load recommended by equipment manufacturer. When equipment can be filled with fluid, use loads that incorporate equipment load and load imposed by fluid.
 - b. Pipe Hangers and Supports: Use full weight of pipe, and fluid contained in pipe that are tributary to the support plus the full weight of valves and accessories located between the hanger or support being anchored and the next hanger or support.
 - c. Hangers and Supports for Electrical Systems, and HVAC, Plumbing, and Fire Suppression Systems and Piping: Use the full weight of supported system that is tributary to the support plus the full weight of accessories located between the hanger or support being anchored and the next hanger or support. When piping or equipment is to be filled with fluid, anchor systems shall be sized to support such loads in addition to the weight of the equipment, piping, or system, as applicable.
 - d. Delegated Design: When anchor systems are used for supporting materials, equipment, or systems delegated to a design professional retained by CONTRACTOR, Subcontractor, or Supplier, provide anchor system suitable for loads indicated in delegated design documents and consistent with the design intent expressed in the Contract Documents.

C. Application:

1. Anchor Bolts:
 - a. Where anchor bolt is shown or indicated, use cast-in-place anchor bolt unless another anchor type is approved by ENGINEER.
 - b. Provide anchor bolts as shown or indicated, or as required to secure structural element to appropriate anchor surface.
2. Concrete Adhesive Anchors:
 - a. Use where adhesive anchors are shown or indicated for installation in concrete.
 - b. Suitable for use where subject to vibration.
 - c. Suitable for use in exterior locations or locations subject to freezing.
 - d. Suitable for use in submerged, intermittently submerged, or buried locations.
 - e. Do not use in overhead applications, unless otherwise shown or approved by ENGINEER.

- f. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.
- 3. Concrete Masonry Adhesive Anchors:
 - a. Use where adhesive anchors are shown or indicated for installation in grout-filled or hollow masonry units.
 - b. Suitable for use where subject to vibration.
 - c. Suitable for use in exterior locations or locations subject to freezing.
 - d. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.
- 4. Concrete Inserts:
 - a. Use only where shown or indicated in the Contract Documents.
 - b. Allowed for use to support pipe hangers and pipe supports for pipe size and loading recommended by the concrete insert manufacturer.

2.02 MATERIALS

A. Anchor Bolts:

- 1. All locations: Provide stainless steel straight threaded rods complying with ASTM F593, AISI Type 316, Condition A, with ASTM F594, AISI Type 316, stainless steel nuts. Embedded anchor bolts shall be headed type and hooked bolts are unacceptable.
 - a. Stainless steel straight threaded rod shall comply with ductility requirements of ACI 350 or ACI 318 Appendix D, Section 0.3.3.
- 2. Equipment: Provide anchor bolts complying with material requirements of this Section and equipment manufacturer's requirements relative to size, embedment length, and anchor bolt projection. Anchor bolts shall be straight threaded rods with washers and nuts as specified in this Section. Hooked bolts are unacceptable.
- 3. Anchoring of Structural Elements: Provide anchor bolts of size, material, and strength shown or indicated in the Contract Documents.

B. Concrete Adhesive Anchors:

- 1. General:
 - a. Adhesive anchors shall consist of threaded rods anchored into hardened concrete using an adhesive system.
- 2. Products and Manufacturers: Provide one of the following:
 - a. HIT-HY 200 Adhesive Anchoring System, by Hilti Fastening Systems, Inc.

- b. C6 Adhesive Anchoring System by Red Head.
3. Adhesives
- a. Epoxy adhesives shall comply with physical requirements of ASTM C881/C881M, Type IV, Grade 2 and 3, Class A, B, and C, except gel times.
 - b. Adhesives shall have a current evaluation report by ICC Evaluation Service for use in both cracked and uncracked concrete with seismic recognition for SOC A through F as tested and assessed in accordance with ICC-ES AC308.
4. Anchor:
- a. Provide continuously-threaded, AISI Type 316 stainless steel adhesive anchor rod. Threaded rods shall comply with the concrete adhesive anchor manufacturer's specifications as included in the ICC Service Evaluation Report for the anchor submitted. Nuts shall have specified proof load stresses equal to or greater than the minimum tensile strength of the stainless steel threaded rod used.
 - b. Stainless steel threaded rod shall comply with ductility requirements of ACI 350 or ACI 318 Appendix D, Section D.3.3.
- C. Concrete Masonry Adhesive Anchors:
1. General:
- a. Grout-filled concrete masonry adhesive anchors shall consist of threaded rods anchored into grout-filled concrete block masonry using an adhesive system.
 - b. Hollow concrete masonry adhesive anchors shall consist of threaded rods with a cylindrical mesh steel or plastic screen tube anchored into hollow concrete block masonry using an adhesive system.
2. Products and Manufacturers: Provide one of the following:
- a. HBU-38 Umbrella Insert with A7 Adhesive, by Red Head.
 - b. Acrylic-Tie Adhesive, by Simpson Strong-Tie Company, Inc.
3. Adhesive:
- a. Adhesive system shall use two-component adhesive mix.
 - b. Hybrid adhesives shall comply with the following:
 - 1) ASTM D695 compressive yield strength greater than 7,200 psi on a seven-day cure.

- c. Adhesives shall have current ICC Evaluation Service Report for use in grout-filled concrete masonry, tested and assessed in accordance with ICC-ES AC 58 and TCC-ES AC 60.
 - 4. Anchor:
 - a. Provide stainless steel adhesive anchor rod complying with ASTM F593, AISI Type 316, Condition CW, with ASTM F594, AISI Type 316 stainless steel nuts.
 - 5. Mesh Screen Tube (for hollow masonry applications):
 - a. Provide with mesh size, length, and diameter as specified by adhesive anchor manufacturer.
- D. Concrete Inserts:
- 1. Manufacturers: Provide products of one of the following:
 - a. Unistrut Corporation
 - b. Cooper B-Line, Inc.
 - c. Anvil International, Inc.
 - 2. Spot Concrete Inserts:
 - a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall comply with ANSI/MSS SP-58, malleable iron, Type 18. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Provide nuts compatible with insert and to suit threaded hanger rod sizes.
 - 3. Continuous Concrete Inserts:
 - a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall be continuous type and shall be manufactured from minimum 2-gage cold-formed channel sections, complying with ASTM A1011/A1011M, stainless steel, Grade 33, complete with Styrofoam inserts, end caps, and means for attaching to forms. Provide channel nuts compatible with insert suitable for threaded hanger rod sizes.
 - 4. Provide inserts with plain finish.

PART 3- EXECUTION

3.01 INSPECTION

- A. Examine conditions under which materials will be installed and advise ENGINEER in writing of conditions detrimental to proper and timely completion of

the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Anchor Bolts:

1. Provide anchor bolts as shown or indicated in the Contract Documents, or as required to secure structural element to the appropriate anchor surface.
2. Locate and accurately set anchor bolts using templates or other devices as required, prior to placing concrete. Wet setting of anchor bolts is unacceptable.
3. Protect threads and shank from damage during installation and subsequent construction operations.

B. Adhesive Anchors-General:

1. Prior to drilling, locate existing reinforcing steel in vicinity of proposed holes. If reinforcing conflicts with proposed hole location, obtain ENGINEER's approval of alternate hole locations to avoid drilling through or damaging existing reinforcing bars.

C. Adhesive Anchors:

1. Comply with manufacturer's written installation instructions and the following.
2. Drill holes to adhesive system manufacturer's recommended drill bit diameter to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits that comply with the tolerances of ANSI B212.15. Core-drilled holes are unacceptable.
3. Before setting adhesive anchor, hole shall be made free of dust and debris by method recommended by adhesive anchor system manufacturer. Hole shall be brushed with adhesive system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
4. Before injecting adhesive, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.
5. Prior to injecting adhesive into the drilled hole, dispense to a location appropriate for such waste, an initial amount of adhesive from the mixing nozzle, until adhesive is uniform color.
6. Inject adhesive into hole through injection system mixing nozzle and necessary extension tubes, placed to bottom of hole. Discharge end shall be withdrawn as adhesive is placed but kept immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during anchor placement.
7. Twist anchors during insertion into partially-filled hole to guarantee full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.

8. Provide adequate curing in accordance to adhesive system manufacturer's requirements prior to continuing with adjoining Work that could place load on installed adhesive anchors. Do not begin adjoining Work until adhesive anchors are successfully tested or when allowed by ENGINEER.
9. Limitations:
 - a. At time of anchor installation, concrete shall have compressive strength (f'c) of not less than 2,500 psi.
 - b. At time of anchor installation, concrete shall have age of not less than 21 days.
 - c. Installation Temperature: Comply with manufacturer's instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that base material temperature complies with anchor systems manufacturer's requirements during installation and curing of adhesive anchor system.
 - d. Oversized Holes: Advise ENGINEER immediately if size of drilled hole is larger than recommended by anchor system manufacturer. Cost of corrective measures, including but not limited to redesign of anchors due to decreased anchor capacities, shall be paid by CONTRACTOR.
 - e. Embedment depths shall be based on installation in normal-weight concrete with compressive strength of 2,500 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.

F. Concrete Inserts:

1. Comply with concrete insert manufacturer's installation instructions.
2. Inserts shall be flush with slab bottom surface.
3. Protect embedded items from damage during concrete placing. Ensure that embedded items are securely fastened to prevent movement during concrete placing, and ensure that embedded items do fill with concrete during concrete placing.
4. Inserts intended for piping greater than four-inch diameter shall be provided with hooked rods attached to concrete reinforcing.

G. Anti-Seizing Compound:

1. Provide anti-seizing compound in accordance with anti-seizing compound manufacturer's installation instructions, at locations indicated in Paragraph 2.1.B of this Section.
2. Do not use anti-seizing compound at locations where anchor bolt or adhesive anchor will contact potable water or water that will be treated to become potable.

3.03 CLEANING

- A. After embedding concrete is placed, remove protection and clean bolts and inserts.

3.04 FIELD QUALITY CONTROL

A. Site Tests – Adhesive Anchors

- 1. CONTRACTOR will employ independent testing agency to perform field quality tensile testing of production adhesive anchors at the Site, unless otherwise specified.
 - a. Testing shall comply with ASTM E488.
 - b. Test at least ten percent of all types of adhesive anchors. If one or more adhesive anchors fail the test, CONTRACTOR shall pay cost of testing, or at ENGINEER's option CONTRACTOR may arrange for testing paid by CONTRACTOR, for all adhesive anchors of same diameter and type installed on the same day as the failed anchor. If anchors installed on the same day as the failed anchor also fail the test, ENGINEER may require retesting of all anchors of the same diameter and type installed in the Work. CONTRACTOR shall be responsible for retesting costs.
 - c. ENGINEER will direct which adhesive anchors are to be tested and indicate test load to be used.
 - d. Apply test loads with hydraulic ram.
 - e. Displacement of post-installed anchors shall not exceed $D/10$, where D is nominal diameter of anchor being tested.

B. Manufacturer's Services:

- 1. Provide at the Site services of qualified adhesive manufacturer's representative during initial installation of adhesive anchor systems to train CONTRACTOR's personnel in proper installation procedures. Manufacturer's representative shall observe to confirm that installer demonstrates proper installation procedures for adhesive anchors and adhesive material.

END OF SECTION

SECTION 03 35 00 CONCRETE FINISHING

PART 1 - GENERAL

1.01 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required to finish cast-in-place concrete surfaces as specified herein.

1.02 SUBMITTALS

Submit to the Owner as provided in the Contract Documents, the proposed chemical hardener manufacturer's surface preparation and application procedures.

1.03 SCHEDULE OF FINISHES

- A. Concrete for the Project shall be finished in the various specified manners either to remain as natural concrete or to receive an additional applied finish or material under another Section.
- B. The base concrete for the following conditions shall be finished as noted and as further specified herein:
 - 1. Exterior, exposed concrete slabs and stairs - broomed finish.
 - 2. Interior, exposed concrete slabs - steel trowel finish.
 - 3. Concrete on which process liquids flow or in contact with sludge - steel trowel finish.
 - 4. Concrete where not exposed in the finished work and not scheduled to receive an additional applied finish or material - off-form finish.
 - 5. Provide concrete surfaces to be left exposed such as walls, columns, beams and joists with smooth rubbed finish.

1.04 RESPONSIBILITY FOR CHANGING FINISHES

- A. The surface finishes specified for concrete to receive additional applied finishes or materials are the finishes required for the proper application of the actual products specified under other Sections. Where different products are approved for use, it shall be the Contractor's responsibility to determine if changes in finishes are required and to provide the proper finishes to receive these products.
- B. Changes in finishes made to accommodate product different from those specified shall be performed at no additional cost to the Owner. Submit the proposed new finishes and their construction methods to the Owner for approval.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Portland cement and component materials required for finishing the concrete surfaces shall be as specified in the Contract Documents.
- B. Hardener shall be Lapidolith as manufactured by Sonneborn Building Products or approved equal. Hardener shall be used on all floors, stair treads and platforms.

PART 3 - EXECUTION

3.01 FORMED SURFACES

- A. Forms shall not be stripped before the concrete has attained a strength of at least 50 percent of the ultimate design strength. This is equivalent to approximately five "100 day-degrees" of moist curing.
- B. Care shall be exercised to prevent damaging edges or obliterating the lines of chamfers, rustications, or corners when removing the forms or doing any work adjacent thereto.
- C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to the satisfaction of the Owner.
- D. Off-form finish. Fins and other projections shall be removed as approved. Tie cone holes and other minor defects shall be filled with non-shrink grout specified under the Contract Documents.

3.02 FLOORS AND SLABS

- A. Floors and slabs shall be screeded to the established grades and shall be level with a tolerance of 1/8-inch when checked with a 10 foot straight edge, except where drains occur, in which case floors shall be pitched to drains as indicated. Failure to meet either of above shall be cause for removal, grinding, or other correction as approved by the Owner.
- B. Following screeding as specified above, power steel trowel as follows:
 - 1. Immediately after final screeding, a dry cement/sand shake in the proportion of 2-sacks of portland cement to 350-pounds of coarse natural concrete sand shall be sprinkled evenly over the surface at the rate of approximately 500 pounds per 1,000 square feet of floor. Neat, dry cement shall not be sprinkled on the surface. This shake shall be thoroughly floated into the surface with an approved disc type power compacting machine weighing at least 200 pounds if a 20-inch disc is used or 300 pounds if a 24-inch disc is used (such as a "Kelly Float" as manufactured by the Weisner-Rapp Corporation of Buffalo, New York). A

mechanical blade-type float or trowel is not acceptable for this work.

NOTE: This operation (application of the cement/sand shake) may be eliminated at the discretion of the Owner if the base slab concrete exhibits adequate fattiness and homogeneity.

2. In lieu of power steel troweling, small areas as defined by the Owner shall be compacted by hand steel troweling with the dry cement/sand shake as ordered.
 3. The floor or slab shall be compacted to a smooth surface and the floating operation continued until sufficient mortar is brought to the surface to fill all voids. The surfaces shall be tested with a straight edge to detect high and low spots which shall be eliminated.
 4. Compaction shall be continued only until thorough densification is achieved and a small amount of mortar is brought to the surface. Excessive floating shall be avoided.
- C. After Paragraph 3.02 A and B procedures are accomplished, floors and slabs for particular conditions shall be completed as scheduled in one of the following finishes:
1. Wood float finish. Hand wood float, maintaining the surface tolerance to provide a grained, nonslip finish as approved.
 2. Broomed finish. Hand wood float maintaining the surface tolerance and then broom with a stiff bristle broom in the direction of drainage to provide a nonslip finish as approved.
 3. Steel trowel finish. Hand steel trowel to a perfectly smooth, hard even finish free from high or low spots or other defects as approved.
- D. Floors, stair treads and platforms shall be given a floor hardener. Application shall be according to manufacturer's instructions.

3.03 APPROVAL OF FINISHES

- A. All concrete surfaces will be inspected during the finishing process by the Owner.
- B. Surfaces which, in the opinion of the Owner, are unsatisfactory shall be refinished or reworked until approved by the Owner.

END OF SECTION

SECTION 03 60 00 GROUTING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This Section includes grouting of equipment bases and such locations as shown on the Drawings and as specified.
- B. The types of grouting include the following:
 - 1. Portland Cement Grout
 - 2. Non-shrink, Non-expanding Grout

1.02 DELIVERY AND STORAGE

- A. Prevent damage to or contamination of grouting materials during delivery, handling and storage.
- B. Store all grouting materials in undamaged condition with seals and labels intact as packaged by the manufacturer.

1.03 SUBMITTALS

- A. All submittals shall be in accordance with Specification Section 01 33 00 – Shop Drawings, Project Data and Samples.

PART 2 - PRODUCTS

2.01 PREMIXED GROUTS

- A. Portland Cement Grout
- B. (For grouting CMU cells and similar items – $f'c=3000$ psi minimum)
 - 1. Portland Cement: ASTM C150, Type II
 - 2. Sand: ASTM C33, Fine Aggregate
 - 3. Water: Potable
 - 4. Pea Gravel: ASTM C33. Coarse aggregate, graded so that at least 90% passes 3/8-inch sieve and 90% is retained by a number 4 sieve.
- C. (Grout Mortar for use as fillets and leveling)
 - 1. Portland Cement: ASTM C150, Type II
 - 2. Sand: ASTM C33, Fine Aggregate (Marson's sand)
 - 3. Water: Potable

4. Mix 1-part Portland cement to 3-parts sand.
- D. Pre-Mixed non-shrink, Non-expanding Grout (Nonmetallic). Non-shrink grout as shown on the Drawings shall be a mixture of selected silica sands, Portland cement, water reducing agents, plasticizing and shrinkage compensating agents. Grout shall be nonmetallic non-corrosive, non-staining and comply with CRD-C-588, Type D.
- E. The grout shall be non-shrink in accordance with ASTM C827, ASTM C191, and ASTM C109. The water-grout ratio shall be approximately 8 to 10 quarts of water per cubic foot of grout adjustable for varying job conditions.
- F. Grout shall not contain calcium chloride or other salt; aluminum or other metals; chemical additives, gypsum or expansive cements. Grout shall not expand after set.
- G. Grout shall be used and applied in accordance with the manufacturer's written instructions.
- H. Subject to compliance with requirements provide from the following:
 1. L&M Construction Chemicals, Inc. – Crystex
 2. Grout Corp. - Five Star Non-shrink Grout or equivalent

2.02 NONSHRINK GROUT

- A. Non-shrink grout shall conform to the following requirements:
 1. Manufactured under rigid quality control specifically for grout used in transferring heavy loads.
 2. Contain nonmetallic aggregates specially graded to minimize bleeding.
 3. Have an initial setting time of approximately one hour at 70°F.
 4. Produce no settlement or drying shrinkage at 3 days or later.
 5. Have higher strength at all ages than plain cement grout of the same flowability.
 6. Resist attack by oil and water and have lower absorption than plain cement grout of the same flowability.
 7. Minimum compressive strength, in accordance with ASTM C-109, shall be 2500 psi after 1 day and 7000 psi after 28 days.

2.03 MIXES

- A. For less than 2-inch clearance, or where size or shape of space makes grouting difficult, grout mix shall consist of Portland cement, fine aggregate and water.
- B. For greater than 2-inch clearances where coarse aggregate will not obstruct free passage of the grout, extend grout by adding 50 pounds of pea gravel per 100 pounds grout material.

- C. Use minimum amount of water necessary to produce a flowable grout without causing either segregation or bleeding.
- D. Portland cement mortar for raked-out edges of non-shrink grout: one part Portland cement, two parts sand and 0.50 part water by weight.

2.04 MIXING

- A. Mix grout in accordance with manufacturer's printed specifications.
- B. Mix grouting materials and water in a mechanical mixer for no less than 3-minutes.
- C. Mix grout as close to the work area as possible and transport the mixture quickly and in a manner that does not permit segregation of materials.
- D. After the grout has been mixed, do not add more water for any reason.

PART 3 - EXECUTION

3.01 PROCEDURES

- A. Installation methods and procedures shall be approved by Engineer and shall be in accordance with manufacturer's printed specifications before work is begun.

3.02 SURFACE PREPARATION

- A. Surface preparation shall be in accordance with manufacturer's printed specifications.
- B. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by bush-hammering, chipping, or other similar means, until a sound, clean concrete surface is achieved.
- C. Lightly roughen the concrete, but not enough to interfere with the proper placement of grout. Cover concrete areas with waterproof membrane until ready to grout. Immediately before grouting remove waterproof membranes and clean any contaminated surfaces.
- D. Remove foreign materials from metal surfaces in contact with grout. Align, level and maintain final positioning of all components to be grouted.
- E. Saturate concrete surfaces with clean water; remove excess water and leave none standing.

3.03 PLACING

- A. Placing shall be in accordance with manufacturer's printed specifications.

City of Clearwater

**NE WRF MCC-1, DC1 & 2 REPLACEMENT
17-0028-UT
00992-0254**

***Grouting
03 60 00-3***

- B. Place non-shrink grouting material quickly and continuously by the most practical means permissible; pouring, pumping or under gravity pressure.
- C. Do not use either pneumatic-pressure or dry packing methods without written permission of the Engineer.
- D. Apply grout from one side only to avoid entrapping air.
- E. Final installation shall be thoroughly compacted and free from air pockets.
- F. Do not vibrate the placed grout mixture or allow it to be placed if the area is being vibrated by nearby equipment.
- G. Do not remove leveling shims for at least 48 hours after grout has been placed. After shims have been removed, fill voids with plain cement-sand grout.
- H. After non-shrink grout has reached initial set, rake out exposed edges approximately 1-inch into the grouted area and paint with Portland cement mortar.

3.04 CURING

- A. Cure grout for 3-days after placing by keeping wet and covering with curing paper or by another approved method.

END OF SECTION

SECTION 04 40 00 MASONRY

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. Contractor shall provide labor, materials, equipment, and incidentals as shown, specified and required for masonry Work, including:
 - a. Providing openings in unit masonry construction to accommodate the Work under this and other Specification Sections and building into unit masonry construction all items such as sleeves, anchorage devices, inserts and other items to be embedded in unit masonry construction for which placement is not specifically provided under other Specification Sections.
2. Extent of each type of unit masonry is shown.
3. Types of products and features required include:
 - a. Concrete unit masonry.
 - b. Masonry mortar and grout.
 - c. Masonry accessories.

B. Coordination:

1. Review installation procedures under other Specification Sections and coordinate the items that must be installed with unit masonry construction Work.
2. Unit masonry construction done without built-in flashings and other built-in Work shall be removed and rebuilt at no additional cost to the Owner, even if discovered after apparent completion of unit masonry construction.
3. Coordinate Work under other Specification Sections to avoid delay of masonry construction.

1.02 REFERENCES

A. Referenced Standards: Standards referenced in this Section are:

1. TMS 402-16, Building Code Requirements for Masonry Structures.
2. TMS 602-16, Specification for Masonry Structures.
3. ASTM A36, Standard Specification for Carbon Structural Steel.
4. ASTM A82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
5. ASTM A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and

- Steel Hardware.
- 6. ASTM C90, Standard Specification for Hollow Load-Bearing Concrete Masonry Units.
- 7. ASTM C91, Standard Specification for Masonry Cement.
- 8. ASTM C140, Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
- 9. ASTM C150, Standard Specification for Portland Cement.
- 10. ASTM C270, Standard Specification for Mortar for Unit Masonry.
- 11. ASTM C331, Standard Specification for Lightweight Aggregates for Concrete Masonry Units.
- 12. ASTM C387, Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
- 13. ASTM C404, Standard Specification for Aggregates for Masonry Grouts.
- 14. ASTM C780, Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- 15. ASTM C1019, Standard Test Method for Sampling and Testing Grout.
- 16. NCMA, Guide Specifications and Technical Bulletins.

1.03 QUALITY ASSURANCE

A. Qualifications:

- 1. Installer: Hire a single installer regularly engaged in preformed unit masonry installation and with successful and documented experience in erecting unit masonry of scope and type of Work required; and employs only tradesmen with specific skill and successful experience in this type of Work. Submit name and qualifications to Owner with the following information for at least three successful, completed projects:
 - a. Names and telephone numbers of owners, architects or engineers responsible for project.
 - b. Approximate contract cost of unit masonry for which installer was responsible.
 - c. Amount (square feet) of unit masonry installed.
- 2. Laboratory Qualifications:
 - a. Testing Laboratory: In accordance with ASTM C1093.

B. Component Supply and Compatibility:

- 1. Obtain each type of concrete masonry unit from one Supplier, cured by one process and of uniform texture and color, or in an established uniform blend thereof.
- 2. Do not change source or brands of mortar products during the Project.
- 3. Where question of compliance to requirements of this Section arise, mortar properties Specification will take precedence over mortar proportion Specification.

4. Do not change proportions established for mortar accepted under property Specifications, and do not use products with different physical characteristics in mortar used in the Work, unless compliance with requirements of property Specifications is re-established by submitting acceptable data to Owner.
5. Do not combine two air-entraining materials in mortar.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Submit the following:
 - a. Shop Drawings showing location, extent and accurate configuration and profile of all items shown, specified, and required by this and other Specification Sections included in unit masonry construction.
 - b. Shop Drawing for fabrication, bending, and placement of reinforcing bars. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabricating and placing reinforcing for unit masonry Work.
2. Product Data: Submit the following:
 - a. Copies of manufacturer's specifications and test data for each type of concrete masonry unit specified, including certification that concrete masonry unit complies with Contract Documents. Include instructions for handling, storage, installation and protection of each type of concrete masonry unit.

B. Informational Submittals:

1. Source Quality Control Submittals: Submit the following:
 - a. Pre-construction laboratory test results, per ASTM C140.
2. Qualifications: Submit the following:
 - a. Testing laboratory.
 - b. Installer.

1.05 JOB CONDITIONS

- A. Temporary Facilities: Provide supplemental heat sources and equipment as required should Contractor desire to continue unit masonry Work in cold weather. Pay for fuel for supplemental heat.
- B. Environmental Requirements:

1. Do not perform unit masonry Work when air temperature is below 28 degrees F on a rising temperature, or below 36 degrees F on falling temperatures without providing temporary, heated enclosures, or without providing temporary heating or other precautions to prevent freezing.
 2. Do not use frozen products, and do not build upon frozen unit masonry Work.
 3. Remove and replace all unit masonry Work damaged by cold.
- C. Hot Weather Unit Masonry Work: Protect unit masonry Work by methods acceptable to Owner from direct exposure to wind and sun when surrounding air temperature is 99 degrees F in the shade with relative humidity less than 50 percent.

PART 2 - PRODUCTS

2.01 MORTAR MATERIALS

- A. Portland Cement: Provide the following for Portland cement-lime mortars:
1. ASTM C150, Type I.
 2. Use ASTM C150, Type III high-early strength, for laying masonry when air temperature is less than 50 degrees F.
 3. Provide non-staining Portland cement of natural color.
- B. Masonry Cement: Provide the following for masonry cement mortars:
1. ASTM C91 Type S, proportioned to comply with ASTM C270.
 2. Maximum Air Content, ASTM C91: 12 percent.
 3. Non-staining.
- C. Hydrated Lime: ASTM C207 Type S, or lime putty ASTM C5.
- D. Sand Aggregates:
1. ASTM C144, except for joints less than ¼-inch, use aggregate graded with 100 percent passing the No. 16 sieve.
 2. White Mortar Aggregates: Provide natural white sand or ground white stone for Portland cement-lime mortars.
 3. Colored Mortar Aggregates: Provide ground marble, granite, or other sound stone as required to match the sample approved by Owner for Portland cement-lime mortars.
 4. Fine Aggregate for Grout: Sand, ASTM C404, Size No. 1.
 5. Course Aggregate for Grout: ASTM C404, Size No. 8 or Size No. 89.
- E. Ready-mixed Mortar: Cementitious materials, water, and aggregate complying with requirements specified for mortar materials, combined with set-controlling admixtures to produce a ready-mixed mortar complying with ASTM C270 and C387.

- F. Water: Free from injurious amounts of oils, acids, alkalis, or organic matter, and clean, fresh, and potable.

2.02 MORTAR MIXES

A. General:

1. Anti-freeze Admixture or Agents: Not allowed.
2. Calcium Chloride: Not allowed.

- B. Mortar for Unit Masonry: Comply with ASTM C270, Table 2, except limit materials to those specified in this Section, do not substitute ASTM C91 masonry cement for ASTM C150 Portland cement without a submittal approval by Owner, and limit cement to lime ratio by volume as follows:

1. Type S:

- a. Provide the following proportions by volume:

- 1) Portland Cement: 1/2 part.
- 2) Masonry Cement: One part.
- 3) Aggregate Ratio (measured in a damp loose condition): Not less than 2-1/4 and not more than three times the sum of the volumes of cementitious materials.

- b. Properties:

- 1) Average Compressive Strength, ASTM C 270: 1800 pounds per square inch.
- 2) Minimum Water Retention, ASTM C 270: 75 percent.
- 3) Maximum Air Content, ASTM C 270: 18 percent.

C. Grout:

1. Fine Grout:

- a. Provide the following proportions by volume:

- 1) Portland Cement: One part.
- 2) Hydrated Lime or Lime Putty: Zero to 1/10 part.
- 3) Aggregate Ratio (Measured in a Damp Loose Condition): Sand shall be not less than 2.25 times and not more than three times sum of volumes of cement and lime.

- b. Mix grout to have a slump of ten inches plus or minus one-inch at placement.

2. Coarse Grout:

- a. Provide the following proportions by volume:
 - 1) Portland Cement: One part.
 - 2) Hydrated Lime or Lime Putty: Zero to 1/10 part.
 - 3) Fine Aggregate Ratio (Measured in a Damp Loose Condition): Sand shall be not less than 2.25 times and not more than three times sum of volumes of cement and lime.
 - 4) Coarse Aggregate Ratio: Not less than one and not more than two times sum of volumes of cement and lime.
- b. Mix grout to have slump of ten inches plus or minus one-inch, at placement.

2.03 CONCRETE MASONRY UNITS

- A. General: Concrete masonry units shall comply with requirements below.
- B. Hollow Load-bearing Concrete Masonry Units: ASTM C90, with minimum of 15 percent coal fly ash.
- C. Size: Manufacturer's standard units with nominal face dimensions of 16 inches long by eight inches high by nominal width dimension shown on Drawings (15-5/8-inches by 7-5/8-inches actual).
- D. Waterproofing Admixture: Manufacture all types of concrete unit masonry, used in construction of exterior walls with an integral waterproofing admixture as follows:
 - 1. Material: Cross-linking acrylic polymer.
 - 2. Proportion: In strict accordance with manufacturer's instructions.
 - 3. Products and Manufacturers: Provide products of one of the following:
 - a. Dry-Block System by Forrer Industries, a Unit of W. R. Grace & Company Construction Products Division.
 - b. Eucon Blocktite by Euclid Chemical Company.
 - c. Or equal.
- E. Exposed Faces: Provide manufacturer's standard color and texture.
- F. Provide two-core concrete masonry units.

2.04 MASONRY ACCESSORIES

- A. Continuous Horizontal Wire Reinforcing and Ties for Masonry: Provide the following unless otherwise shown:

1. General: Welded wire units prefabricated in straight lengths of not less than ten feet, with matching corner "L" and intersection "T" units. Fabricate from cold-drawn steel wire complying with ASTM A82, with deformed continuous 3/16-inch gage side rods and plain 9 gage cross rods, crimped for cavity wall construction, with unit width of 1.5 to two inches less than thickness of wall or partition. All reinforcing and ties shall be hot dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A153, Class B-2, unless otherwise specified.
 2. For single-wythe masonry, use units fabricated as follows:
 - a. Truss-type fabricated with one horizontal rod beneath each unit masonry shell wall and continuous diagonal cross-rods spaced not more than 16 inches on centers.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Lox and all Truss Reinforcement with #120 Truss-Mesh by Hohmann and Barnard, Inc.
 - 2) Or equal.
- B. Anchoring Devices for Masonry: Provide the following, unless otherwise shown:
1. General: Provide the following:
 - a. Cold rolled steel sheet complying with ASTM A1008, hot-rolled steel sheet and strip complying with ASTM A1011, plates and bars complying with ASTM A36 and cold drawn steel wire complying with ASTM A82, all hot-dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A153.
 - b. Rectangular, corrugated, one-inch wide ties, fabricated of 12-gage sheet metal, unless otherwise specified.
 - c. Flexible Anchors: When masonry abuts structural walls or framework provide flexible anchors that allow horizontal and vertical movement of masonry, but provide lateral restraint.
 2. Compressible Filler: Provide watertight joint filler where unit masonry construction abuts structural framework members, or as shown. Provide the following:
 - a. Polyurethane foam strip saturated with polybutylene waterproofing material which, when installed at a compression ratio of two-to-one, is impermeable to water.
 - b. Resilient to -40 degrees F with 100 percent movement recovery.
 - c. Elongation of 140 percent with a tensile strength of not less than 53 pounds per square inch.
 - d. Products and Manufacturers: Provide products of one of the following:
 - 1) Polytite Standard by Polytite Manufacturing Corporation.

- 2) Polyseal by Sandell Manufacturing Company, Inc.
 - 3) Or equal.
3. Reinforcing Bars:
- a. Deformed carbon steel, ASTM A615, Grade 60 for bars No. 3 to No. 8 except as otherwise shown.

2.05 SOURCE QUALITY CONTROL

- A. Allowable Tolerances: For concrete masonry units provide the following:
1. Face Dimension: Total variation in finished and installed face dimensions of units shall not exceed 1/16-inch between largest and smallest units in each lot of units of each size.
 2. Distortion: Distortion of plane and edges of face of individual units, as installed, from corresponding plane surface and edges of prefaced concrete masonry unit, shall not exceed 1/16-inch.
 3. Top and Bottom Surfaces: Ground to provide finish height of 7-5/8 inches plus or minus 1/16-inch.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Contractor and installer shall examine areas and conditions under which unit masonry construction Work will be installed, and notify the Owner of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the Owner.

3.02 PREPARATION

- A. Measurement of Mortar Materials:
1. Cement and Hydrated Lime: Batched by the bag.
 2. Sand: Batched by volume in suitably calibrated containers, provided proper allowance is made for bulking and consolidation and for weight per cubic foot, of contained moisture.
 3. Proportion of Volumetric Mixtures: One 94-pound sack of Portland cement and one 50-pound sack of hydrated lime constitute nominal one cubic foot.
 4. Shovel measurement: Not allowed.
- B. Mortar Mixing:
1. Type of Mixer: Machine mix in approved mixer in which quantity of water is accurately and uniformly controlled.
 2. While mixer is in operation add approximately three-quarters of required water, half the sand, all the cement, then add remainder of sand.

3. Allow batch to mix briefly then add water in small quantities until satisfactory workability is obtained.
 4. Mix for at least five minutes after all materials have been added.
 5. Hydrated Lime for Mortar Requiring Lime Content: Use dry-mix method. Turn over materials for each batch together until even color of mixed, dry materials indicates that cementitious material has been thoroughly distributed throughout mass, then add water to obtain required plasticity.
 6. Lime putty, if approved for use, shall be prepared in accordance with ASTM C5.
 7. Mixer drum shall be completely emptied before recharging next batch.
 8. Re-tempering of mortar is not allowed.
- C. Wetting of Masonry Units:
1. Concrete Masonry Units: Except for absorbent units specified to be wetted, lay masonry units dry. Do not wet concrete masonry units.
- D. Cleaning Reinforcement: Before being placed, remove loose rust, mill scale, earth, ice, and other coatings except galvanizing from reinforcement. Do not use reinforcing bars with kinks or bends not shown on Drawings or approved Shop Drawings, or bars with reduced cross-section.

3.03 INSTALLATION, GENERAL

- A. Thickness: Build walls, floors and other unit masonry construction work to thickness shown. Build single-wythe walls to actual thickness of masonry units using units of nominal thickness shown or specified.
- B. Leave openings for equipment, piping, ducts, and other items to be installed subsequent to start of masonry Work. After installing said items, complete unit masonry Work to match Work immediately adjacent to openings.
- C. Cut masonry units using wet cutting, motor driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining Work neatly. Use full size units without cutting wherever possible.
- D. Match Existing Masonry: Match coursing, pattern bond, color, texture and size of new unit masonry with adjacent, existing masonry.

3.04 LAYING MASONRY WALLS

- A. General:
1. Mortar Types: Unless otherwise indicated, use mortar as specified and as follows:
 - a. For all Work, use S mortar.
 - b. Use coarse grout fill for structural requirements and for grouting reinforcing steel in unit masonry construction Work.

- c. Do not use mortar that has begun to set or if more than 30 minutes have elapsed since initial mixing. Re-temper mortar during the 30-minute period only as required to restore workability.
 2. Avoid using less than half-size units at corners, jambs, and where possible at other locations.
 3. Lay up walls plumb and true to comply with specified tolerances, with courses level, accurately spaced, and coordinated with other Work.
- B. Construction Tolerances:
 1. Variation from Plumb: For lines and surfaces of columns, walls and arises, do not exceed 1/4-inch in 10 feet, or 3/8-inch in a story height (20 feet maximum), nor two-inch in 40 feet or more. Except for external corners, expansion joints and other conspicuous lines, do not exceed 1/4-inch in any story or 20 feet maximum, nor two-inch in 40 feet or more.
 2. Variation from Level: For lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4-inch in any bay or 20 feet maximum, nor 3/4-inch in 40 feet or more.
 3. Variation of Linear Building Line: For position shown and related portion of columns, walls and partitions, do not exceed two-inch in any bay or 20 feet maximum, nor 3/4-inch in 40 feet or more.
 4. Variation in Cross-sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4-inch nor plus two-inch.
- C. Mortar Bedding and Jointing:
 1. Lay hollow masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout.
 - a. Maintain joint widths shown, except for minor variations required to maintain pattern bond alignment. Lay walls with 3/8-inch joints.
 2. Cut joints flush for masonry walls that are to be concealed or to be covered by other materials, except paint, unless otherwise shown.
 3. Tool exposed joints, when mortar is "thumbprint" hard, slightly concave. Rake out mortar in preparation for application of calking or sealants where required.
 4. Concave-tool exterior joints below grade.
 5. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

- D. Stopping and Resuming Work: Rake back half-unit masonry length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly, if required, and remove loose masonry units and mortar prior to laying new masonry.
- E. Built-in Work:
1. As the Work progresses, build in items shown, specified or required by others. Fill cores in one block width solidly with masonry around built-in items.
 2. Where built-in items are to be embedded in cores of hollow masonry units, place layer of cavity fill mesh in joint below and rod mortar or grout into core.
- F. Horizontal Joint Reinforcing:
1. Provide continuous horizontal joint reinforcing as specified. Fully embed longitudinal side rods in mortar for their entire length with minimum cover of 5/8-inch on exterior side of walls and 1/2-inch at other locations. Lap reinforcement minimum of six inches at ends of units. Do not bridge masonry control joints with reinforcing.
 2. Reinforce all masonry walls with continuous horizontal joint reinforcing unless specifically noted or specified to be omitted.
 3. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units in accordance with manufacturer's written instructions.
 4. Space continuous horizontal reinforcing as follows:
 - a. Space reinforcing at 16 inches on centers vertically, unless otherwise shown.
 5. Reinforce masonry openings greater than 12 inches wide, with horizontal joint reinforcing placed in two horizontal joints approximately eight inches apart, immediately above lintel and immediately below sill. Extend reinforcing minimum of 2.0 feet beyond jambs of opening.
 6. In addition to wall reinforcing, provide additional reinforcing at openings as required to comply with the Contract Documents.
- G. Structural Reinforced Unit Masonry Construction:
1. Comply with the requirements of ACI 530.1 and applicable codes.
- H. Grouting Structural Reinforced Unit Masonry Construction:
1. Comply with requirements of ACI 530.1 and applicable codes.
- I. Anchoring Masonry Work:

1. Provide anchoring devices of type specified. If not shown or specified, provide standard type for facing and back up involved in compliance with requirements of Laws and Regulations.
2. Anchor masonry to structural members where masonry abuts or faces such members to comply with the following:
 - a. Provide an open space not less than 1/2-inch or more than one-inch in width between masonry and structural member, unless otherwise shown. Keep open space free of mortar and other rigid materials.
 - b. Provide end blocks where masonry abuts structural support to facilitate installation of compressible filler, fire-safing insulation, backer rod, and sealant.

J. Bond Beams:

1. Provide masonry bond beams where openings of 16 inches or more are shown. Provide formed in place masonry lintels and bond beams. Temporarily support formed-in-place lintels and bond beams.
 - a. Unless otherwise shown, provide one horizontal number six deformed reinforcing bar for each 4 inches of wall thickness.
 - b. For hollow masonry unit walls, use specially formed "U"-shaped lintel and bond beam units with reinforcing bars placed as shown, filled with coarse grout as specified.
2. Provide minimum bearing at each jamb of eight inches for all openings.
3. On concrete unit masonry walls where pattern bond remains visually exposed, increase minimum bearing of masonry lintels to maintain joint pattern of wall and install to be indistinguishable from surrounding masonry.

K. Protection:

1. Protect unit masonry construction Work from deterioration, discoloration or damage during subsequent construction operations.

3.05 FIELD QUALITY CONTROL

- A. Contractor shall hire independent testing laboratory acceptable to Owner to take samples and conduct tests to evaluate air entrainment, water retention, and compliance of products with Contract Documents, and to determine compressive strength of mortar and grout. Conduct tests in accordance with ASTM C91. Provide tests results to Owner prior to commencement of Work.
- B. After initial test, the Owner will require maximum of five additional tests to be conducted at the Owner's discretion.
- C. Test and inspect all load-bearing concrete unit masonry during construction, meeting the requirements of Level 3 Quality Assurance as defined by ACI 530.1.

- D. Masonry walls that do not meet requirements of Special Inspections shall be repaired in manner acceptable to Owner at no expense to Owner.

END OF SECTION

SECTION 05 40 00 COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Load-bearing wall framing.
- B. Interior non-load-bearing wall framing, for framing that exceeds height limitations of standard, nonstructural metal framing.
- C. Floor joist framing.
- D. Related Requirements:
 - 1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.

1.02 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Cold-formed steel framing materials.
 - 2. Load-bearing wall framing.
 - 3. Floor joist framing.
 - 4. Power-actuated anchors.
- B. Shop Drawings:
 - 1. Provide Shop Drawings prepared by cold-formed steel framing manufacturer.
 - 2. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 3. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Member in good standing of the Steel Framing Industry Association (SFIA).
 - 1. Products to be certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS Accreditation Criteria for Inspection Agencies.

- B. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed steel framing that are similar to those indicated for this Project in material, design, and extent.
- D. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- E. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified in accordance with the product-certification program of the Steel Framing Industry Association (SFIA).
- F. Comply with the following AISI specifications and standards:
 - 1. AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members."
 - 2. AISI S200, "North American Standard for Cold-Formed Steel Framing - General Provisions."
 - 3. AISI S201, "North American Standard for Cold-Formed Steel Framing - Product Standard."
 - 4. AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."
 - 5. AISI S240, "North American Standard for Cold-Formed Steel Structural Framing."

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide cold-formed steel framing products by ClarkDietrich; as specified in other Part 2 articles or comparable product by one of the following current members of the SFIA:
 - 1. CEMCO; California Expanded Metal Products Co.
 - 2. Telling Industries.

2.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated on Drawings.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
 - b. Floor Joist Framing: Vertical deflection of 1/360 for live loads and 1/240 for total loads of the span.
 - 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
 - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 1/2 inch (13 mm).
- C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing to comply with AISI S100 and AISI S240.

2.03 COLD-FORMED STEEL FRAMING MATERIALS

- A. Framing Members, General: Comply with AISI S240 for conditions indicated.
- B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: CP 60: G60 (Z180), A60 (ZF180), AZ50 (AZM150)

2.04 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Steel Thickness: 0.0428 inch (1.09 mm).
 - 2. Depth: 3-5/8 inches (92 mm).

3. Flange Width: 1-5/8 inches (41 mm).
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
1. Minimum Base-Steel Thickness: Matching steel studs.
 2. Flange Width: 1-1/4 inches (32 mm).
- C. Headers and Jambs - Heavy-Duty Stud: Manufacturer's proprietary shape used to form header beams and jambs, columns or posts, of web depths indicated, unpunched, with stiffened flanges and as follows:
1. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich; Heavy-Duty Stud (HDS) and Header Bracket (HDSC).
 2. Minimum Base-Steel Thickness: Matching steel studs.
 3. Web Size: 3-5/8 inches (92 mm).
 4. Flange Width: 3 inches (76.2 mm).
 5. Type HDSC Header Bracket: Size as required by design.
 - a. Minimum Base-Steel Thickness: 0.0329 inch (0.84 mm).
- D. Foundation Connections: Manufacturer's standard clips and connectors designed to transfer tension loads between floors or from structural members to the foundation.
1. Shear Wall and Knee Wall Connector:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich; EasyClip (D-Series).
 - b. Minimum Base-Steel Thickness: 0.0677 inch (1.72 mm).

2.05 FLOOR JOIST FRAMING

- A. Steel Floor Joists: Manufacturer's proprietary cold-formed galvanized-steel joists, of web depths indicated, featuring large, extruded holes and as follows:
1. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich; TradeReady Steel
 2. Minimum Base-Steel Thickness: 0.0428 inch (1.09 mm).
- B. Steel Joist Rim Track: Manufacturer's standard U-shaped steel joist track; punched with clip angles at required joist spacing, of web depths indicated; with stiffened webs and as follows:
1. Minimum Base-Steel Thickness: Matching steel joists
 2. Flange Width: 2-1/2 inches (63.5 mm) bottom, minimum.

- C. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Steel Thickness: 0.0428 inch (1.09 mm).
 - 2. Flange Width: 1-5/8 inches (41 mm), minimum.
- D. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Steel Thickness: Matching steel joists.
 - 2. Flange Width: 1-1/2 inches (38 mm), minimum.

2.06 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic-coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, Bridging, and Solid Blocking:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich; Spazzer 5400 Bridging Bar (SPZS)
 - 3. Web Stiffeners:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich; Quick Twist Web Stiffener (QTWS).
 - 4. Anchor Clips:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich; Holdown (CD Series)
 - 5. End clips.
 - 6. Foundation Clips
 - 7. Gusset plates.
 - 8. Stud kickers and knee braces.

2.07 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process in accordance with ASTM A123/A123M.
- B. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

2.08 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780/A780M.
- B. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- C. Shims: Load bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.03 INSTALLATION, GENERAL

- A. Install cold-formed steel framing in accordance with ASTM C1007, AISI S240 and manufacturer's written instructions unless more stringent requirements are indicated.
 1. Cut framing members by sawing or shearing; do not torch cut.
 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

- b. Locate mechanical fasteners, install in accordance with Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- B. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- C. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- D. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- E. Install insulation, specified in Section 09 21 16 "Gypsum Board Assemblies," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- F. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.04 INSTALLATION OF LOAD-BEARING WALL FRAMING

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
 - 1. Anchor Spacing: As indicated on Shop Drawings.
- B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch (3 mm) between the end of wall-framing member and the web of track.
 - 1. Fasten both flanges of studs to top and bottom tracks.
 - 2. Space studs as follows:
 - a. Stud Spacing: 16 inches (406 mm).
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs in accordance with AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

- G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of same-sized components as jambs indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates. A single proprietary jamb member designed specifically for supporting the header may be used in lieu of multiple members.
 - 1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
 - 2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
 - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written instructions and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced vertically as indicated on Shop Drawings. Fasten at each stud intersection.
 - 1. Bar Bridging: Proprietary bridging bars installed in accordance with manufacturer's written instructions.
- J. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.05 INSTALLATION OF JOIST FRAMING

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
 - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.
- C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
 - 1. Joist Spacing: 16 inches (406 mm).
- D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.

- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.
 - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
 - 1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.06 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 ft. (1:960) and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.07 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

3.08 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 50 00 METAL FABRICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Steel framing and supports for mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 3. Miscellaneous steel trim including steel angle corner guards and steel edgings.
 - 4. Metal bollards.
 - 5. Loose bearing and leveling plates for applications where they are not specified in other Sections.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete.
 - 2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
- C. Related Requirements:
 - 1. Division 03 - Concrete for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.

1.03 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with

integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Galvanizing coating products.
 - 2. Grout.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Steel framing and supports for mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 3. Miscellaneous steel trim including steel angle corner guards and steel edgings.
 - 4. Metal bollards.
 - 5. Loose steel bearing plates.

1.05 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
- B. Welding certificates
- C. Galvanizing coating certificates.
- D. Manufacturers literature for post-installed anchors.

1.06 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."
 - 3. All field welding shall be inspected by a Certified Welding Inspector (CWI), Hired and paid for by the Contractor.

1.07 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M. Wide Flange Sections: ASTM A572/ ASTM A572M.
- C. Stainless-Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 316L.
- D. Stainless-Steel Bars and Shapes: ASTM A276, Type 316L.
- E. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.
- F. Rolled-Stainless-Steel Floor Plate: ASTM A793.
- G. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- H. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- I. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches or As indicated.
 - 2. Material: Galvanized steel, ASTM A653/A 653M, commercial steel, Type B structural steel, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108-inch 0.079-inch 0.064-inch nominal thickness.

2.03 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A325, Type 3 (ASTM A325M, Type 3); with hex nuts, ASTM A563, Grade C3 (ASTM A563M, Class 8S3); and flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F593 (ASTM F738M); with hex nuts, ASTM F594 (ASTM F836M); and flat washers; Alloy Group 1 (A1).
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded type or epoxy adhesive type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329.
- H. Post-Installed Anchors: Torque-controlled epoxy adhesive anchors.
 - 1. Material for All Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).
- I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn5, as needed for fastening to inserts.

2.04 MISCELLANEOUS MATERIALS

- A. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- D. Concrete: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 4500 psi or greater.

2.05 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.06 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.

2.07 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

2.08 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 80 steel pipe 1/4-inch wall-thickness rectangular steel tubing steel shapes, as indicated.
 - 1. Cap bollards with 1/4-inch thick steel plate.

2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Fabricate bollards with 3/8-inch thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
- D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch wall-thickness steel tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4-inch steel machine bolt.

2.09 LOOSE BEARING AND LEVELING PLATES

Provide loose bearing and leveling plates for steel items bearing on concrete construction. Drill plates to receive anchor bolts and for grouting.

- A. Galvanize plates.

2.10 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.11 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.02 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Install pipe columns on concrete footings and slabs with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.03 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
 1. Do not fill removable bollards with concrete.
- B. Anchor bollards to existing construction with expansion anchors, anchor bolts or through bolts. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.
 1. Embed anchor bolts at least 4 inches in concrete.
- C. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete or in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with non-shrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- D. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- E. Anchor internal sleeves for removable bollards in concrete by inserting in pipe sleeves preset into concrete or formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of sleeve. Fill annular space around internal sleeves solidly with non-shrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward internal sleeve.
- F. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- G. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.
- H. Fill bollards solidly with concrete, mounding top surface to shed water.
 1. Do not fill removable bollards with concrete.

3.05 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with non-shrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.06 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

SECTION 05 51 00 STRUCTURAL ALUMINUM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to design, furnish and install structural aluminum members, including beams, columns, stair stringers, stair treads, intermediate platforms, platform grating, handrails, platform columns, horizontal and vertical bracing, surface preparation and shop priming.
2. The extent of structural aluminum shall be as shown on the design drawings.
3. The Work also includes:
 - a. Providing base plates and anchor bolt requirements at column base to concrete foundations.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the aluminum Work.
2. Field verify all dimensions and elevations before installation.

C. Related Sections:

1. Section 03 30 10 "Anchor Systems."
2. Section 05 50 00 "Metal Fabrications."
3. Section 05 52 10 "Pipe and Tube Railings."

1.02 REFERENCES

A. Codes and standards referenced in this Section are listed below:

1. Florida Building code (FBC) 2020 Edition.
2. ASCE 7-16 "Minimum Design Loads for Buildings and Other Structures."
3. ADM1-2015 "Aluminum Design Manual-Part 1-A Specification for Aluminum Structures."
4. American Society for Testing and Materials, (ASTM).
 - a. ASTM B 209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. ASTM B 211, Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.
 - c. ASTM B 221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.

- d. ASTM B 308/B 308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
 - e. ASTM B 429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - f. ASTM F 593, Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
 - g. ASTM F 594, Specification for Stainless Steel Nuts.
5. American Welding Society, (AWS).
- a. AWS D1.2/D1.2M, Structural Welding Code-Aluminum.
6. National Association of Architectural Metal Manufacturers, (NAAMM).
- a. NAAMM, Metal Stairs Manual and Metal Finishes Manual.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
- 1. Manufacturer shall have a minimum of five years experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
- B. Component Supply and Compatibility:
- 1. Obtain all products included in this Section regardless of the component manufacturer from a single aluminum manufacturer.
 - 2. The aluminum fabricator to review and approve to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the aluminum fabricator.
- C. Source Quality Control: Contractor shall be responsible for entire design, fabrication and installation of aluminum canopy and stair Work.
- D. The Shop Drawings and calculations shall be prepared by a Registered Professional Engineer licensed in the State of Florida and is a recognized expert in the type of Work shown and specified.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following:
- 1. Shop Drawings:
 - a. Erection and detailed Shop Drawings, which show the plan location, elevation and details for the fabrication and erection of the aluminum

Work. Show anchorage and accessory items. Include details of all connections between all materials.

2. Delegated Design Submittals:
 - a. Provide signed and sealed Shop Drawings and calculations, which are prepared by a Registered Professional Engineer licensed in the State of Florida.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
- B. Storage and Protection:
 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect materials from corrosion and deterioration.
- C. Acceptance at Site:
 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 DESIGN CRITERIA

- A. Aluminum structures shall comply with the design criteria established on the drawings and specifications.
- B. Pre-engineered aluminum stairs shall comply with additional requirements of the NAAMM, "Metal Stairs Manual".
- C. Sizes of miscellaneous items such as carrier angles and platform stiffeners, and design stresses shall be as recommended in Section 4 of the "Metal Stairs Manual", unless otherwise shown.
- D. All required gravity and wind loadings shall comply with the 2020 Florida Building Code.

2.02 FABRICATION

- A. General:

1. Use welding for joining pieces together, unless otherwise shown or specified. Welding to comply with the applicable provisions of AWS D1.2/D1.2M. Fabricate units so that bolts and other fastenings do not appear on finish surfaces. Make joints true and tight, and make connections between parts light-proof tight. Provide continuous welds, ground smooth where exposed.
 2. Construct units to conform to sizes and arrangements as shown. Provide aluminum framing, hangers, columns, struts, clips, brackets, bearing plates and other components as required. Erect units to line, plumb, square, and true with horizontal runs registering level with floor and platform levels.
 3. Provide brackets and bearing surfaces as detailed and as required to anchor and contain the aluminum structures on the supporting structures.
 4. Finish: Provide architectural mill finish as specified in the NAAMM Manual.
 5. Protection of Aluminum from Dissimilar Materials: Coat all surfaces of aluminum in contact with dissimilar materials, such as concrete, masonry and steel as specified in Division 09 - Finishes.
- B. Stair Framing:
1. Fabricate stringers of structural aluminum channels, or plates, or a combination thereof, as shown. Provide closures for exposed ends of stringers.
 2. Construct platforms of structural aluminum channel headers and miscellaneous framing members, as shown. Bolt or weld headers to stringers. Bolt or weld framing members to strings and headers.
 3. Stair stringer depth shall be no less than 12-inches.
- C. Aluminum Grating Treads and Platforms:
1. For aluminum grating and treads, refer to Division 05.
 2. Fabricate grating treads with abrasive nosing on one edge and with aluminum angle or aluminum plate carrier at each end for stringer connections. Secure treads to stringers with bolts.
 3. Fabricate grating platforms, with nosing matching that on grating treads, at all landings. Provide toe-plates at open-sided edges of floor grating fastened to platform framing members.
 4. Provide platforms 3/8-inch minimum thick with solid abrasive surface matching that on treads. Secure platforms to platform framing members with bolts.
- D. Stair Aluminum Railing:
1. Aluminum railings shall conform to the requirements of Section 05 52 10 Pipe and Tube Railings.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Contractor shall examine the conditions under which the Work is to be installed and notify the Owner, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory

conditions have been corrected.

3.02 PREPARATION

- A. Provide concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Anchor bolts to existing concrete shall be epoxy adhesive type. Mechanical wedge type anchors are not allowed.

3.03 INSTALLATION

- A. Fastening to In-Place Construction:
 - 1. Provide anchorage devices and fasteners where necessary for securing aluminum members to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts and other connectors as required. The anchorage devices and fasteners shall be Type 316 stainless steel. Anchor bolts to existing concrete shall be epoxy adhesive type. Mechanical wedge type anchors are not allowed.
- B. Cutting, Fitting and Placement:
 - 1. Perform cutting, drilling and fitting required for the installation of the aluminum members. Set the aluminum members accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry or similar construction.
 - 2. Fit exposed connections accurately together to form tight hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

END OF SECTION

SECTION 05 52 10 PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Aluminum pipe railings.
- B. Related Sections:
 - 1. Division 05 - Metals

1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: Railings to withstand structural loads indicated.
- C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing

buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
1. Manufacturer's product lines of mechanically connected railings.
 2. Railing brackets.
 3. Grout.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design.
- D. Samples for Verification: For each type of exposed finish required.
1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 2. Fittings and brackets.
 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of finishing and connecting members at intersections.
- E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- C. Welding certificates.

- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication. Provide additional railing posts at middle rail interruption locations.

1.08 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - 1. Aluminum Pipe and Tube Railings:
 - a. Blum, Julius & Co., Inc.
 - b. Hollaender Manufacturing Company.
 - c. Superior Aluminum Products, Inc.
 - d. Tuttle Railing Systems; Div. of Tuttle Aluminum & Bronze, Inc.

2.02 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.03 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars and Tubing: ASTM B 221 (ASTM B 221M), Alloy 6063-T5/T52.
- C. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.
 - 1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B 210 (ASTM B 210M), Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- F. Die and Hand Forgings: ASTM B 247 (ASTM B 247M), Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.04 FASTENERS

- A. General: Provide the following:
 - 1. Aluminum Railings: Type 316 stainless-steel fasteners.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when

installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.05 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.06 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.

- H. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- I. Form changes in direction as follows:
 - 1. As detailed.
- J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of railing members with prefabricated end fittings.
- L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- O. For removable railing posts, fabricate slip-fit sockets from stainless-steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
 - 1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- P. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.07 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.08 ALUMINUM FINISHES

- A. Mechanical Finish: AA-M12 (Mechanical Finish: nonspecular as fabricated).
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.02 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.03 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.04 ANCHORING POSTS

- A. Anchor posts to concrete and metal surfaces with base plates as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For aluminum pipe railings, weld posts to plate and bolt to supporting surfaces. Bolt and plate assembly designed and engineered for this purpose.

3.05 ATTACHING RAILINGS

- A. Attach railings to wall with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

- C. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
 - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt or predrilled hole for exposed bolt anchorage.
 - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

3.06 ADJUSTING AND CLEANING

- A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

3.07 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 07 90 00 SEALANTS AND CAULKING

PART 1 - GENERAL

1.01 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are reread to in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM) Publications: C 920-79 Elastomeric Joint Sealants

1.02 SUBMITTALS

- A. Division 01 – General Requirements
- B. Certificates of Conformance or Compliance: Submit certificates from the manufacturers attesting that materials meet the specified requirements.
- C. Manufacturer's Descriptive Data: Submit complete descriptive data for each type of material. Clearly mark data to indicate the type the Contractor intends to provide. Data shall state conformance to specified requirements. Data for sealant and caulking shall include application instructions, shelf life, mixing instructions for multicomponent sealants, and recommend cleaning solvents.

1.03 DELIVERY AND STORAGE

- A. Deliver materials to the job site in the manufacturers' external shipping containers, unopened, with brand names, date of manufacture, and material designation clearly marked thereon. Containers of elastomeric sealant shall be labeled as to type, class, grade, and use. Carefully handle and store all materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 100 degree F or less than 40 degree F.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Subject to compliance with requirements provide products manufactured by single source.

2.02 MATERIALS

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Products shall conform to the reference documents listed for each use. Color of sealant and calking shall match adjacent surface color unless specified otherwise. For ASTM C 920 sealants, use a sealant that has been tested on the type(s) of substrate to which it will be applied. Interior Calking or Sealant: Provide ASTM C 920, Type M, Grade NS, Class 12.5, Use NT. Color of calking or sealant shall be selected by Owner from manufacturer's full range.
- C. Exterior Sealant: For joints in vertical surfaces, provide ASTM C 920, Type M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type M, Grade P, Class 25, Use T. Color of sealant shall be selected by Owner from manufacturer's full range.
- D. Latex rubber modified, acrylic emulsion polymer sealant compound; manufacturer's standard, one part, nonsag, mildew resistant, acrylic emulsion sealant complying with ASTM C834, formulated to be paintable and recommended for exposed applications on interior locations involving joint movement of not more than plus or minus 5 percent
- E. Floor Joints Sealant: Provide ASTM C-920, Type S or M, Grade P, Class 25, Use T. Color of sealant shall be selected by Owner from manufacturer's standard colors.
- F. Primer for Sealant: Use a non-staining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.
- G. Bond Breakers: Use the type of consistency recommended by the sealant manufacturer for the particular application.
- H. Silicone Joint Sealants: Use Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT
- I. Backstops: Use glass fiber roping or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by the sealant manufacturer. Backstop material shall be compatible with the sealant. Do not use oakum and other types of absorptive materials as backstops.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

- A. Surfaces shall be clean, dry to the touch, and free from frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Where adequate grooves have not been provided, clean out grooves to a depth of ½" and grind to a minimum width of ¼" without damage to the adjoining work. No grinding shall be required on metal surfaces.
- B. Steel Surfaces: Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a solvent that leaves no residue.
- C. Copper or Bronze Surfaces: Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. Use non-staining solvents recommended by the item manufacturer.

3.02 SEALANT PREPARATION

- A. Do not modify the sealant by addition of liquids, solvents, or powders. Mix multicomponent elastomeric sealants in accordance with manufacturer's printed instructions.

3.03 APPLICATION

- A. Backstops: Where joint cavities are constructed deeper than indicated, tightly pack the back or bottom with backstop material to provide a joint of the depth indicated. Install backstops dry and free of tears or holes.
- B. Primer: Just prior to application of the sealant or caulking compound, clean out all loose particles from joints. Apply primer in accordance with compound manufacturer's directions. Do not apply primer to exposed finish surfaces.
- C. Bond Breaker: Provide bond breakers as recommended by the sealant manufacturer for each type of joint and sealant used.
- D. Sealant and Caulking Compounds: Use a compound that is compatible with the material to and against which it is applied. Do not use a compound that has exceeded its shelf life or has become too jelled to be discharged in a continuous flow from the gun. Apply the compound in accordance with the manufacturer's printed instructions. Force the compound into the joints with sufficient pressure to fill the joints solidly. Compound shall be uniformly smooth and free from wrinkles.

- E. Interior Sealant and Caulking: Provide sealant or caulking at all exposed joints in the building and at all joints indicated to receive sealant or caulking.
- F. Exterior Sealant: Provide sealant at all joints around the perimeter of openings and at all exposed joints on the building and at all joints indicated to receive sealant.
- G. Floor Joints Sealants: Provide sealant in all control joints and in other floor joints indicated or specified.
- H. Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated

3.04 PROTECTION AND CLEANING

- A. Protection: Protect areas adjacent to joints from compound smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.
- B. Cleaning: Immediately scrape off fresh compound that has been smeared on masonry and rub clean with a solvent as recommended by the compound manufacturer. Upon completion of compound application, remove all remaining smears and stains resulting therefrom and leave the work in a clean and neat condition.

END OF SECTION

SECTION 08 11 16 - ALUMINUM DOORS AND FRAMES

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Flush aluminum doors.
- B. Aluminum door frames.

1.02 RELATED SECTIONS

- A. Section 07 79 00 – Sealants and Caulking

1.03 REFERENCES

- A. American Architectural Manufacturers Association (AAMA).
 - 1. AAMA 609 - Anodized Architectural Finishes Cleaning and Maintenance.
 - 2. AAMA 701 - Pile Weatherstrip.
- B. American Society for Testing Materials (ASTM).
 - 1. E 330-97e1 - Structural Performance of Exterior Doors.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Manufacturer's descriptive literature for each type of door and frame. Include the following information:
 - 1. Fabrication methods.
 - 2. Finishing.
 - 3. Hardware preparation.
 - 4. Accessories.
- C. Shop Drawings: Indicate the following:
 - 1. Elevations and details of each door and frame type.
 - 2. Schedule of doors and frames.
 - 3. Conditions at openings with various wall thicknesses and materials.
 - 4. Location and installation requirements for hardware.
 - 5. Thicknesses of materials, joints.
 - 6. Connections and trim.
- D. Hardware Templates: Provide finish hardware mounting details.

- E. Manufacturer's Installation Instructions: Printed installation instructions for each product, including product storage requirements.
- F. Operations and Maintenance Data: Printed instructions for each product.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing aluminum door and frame systems of the type required for this project, with minimum ten continuous years documented experience.
- B. Product Qualifications: Wind-load test certification conforming to ASTM E 330 on samples of previous products shall be provided for the type of door to be used.
- C. Installer's Qualifications: Workmen skilled in handling aluminum door and frame systems of the type required for this project.
- D. Instruction: The manufacturer or his representative will be available for consultation to all parties engaged in the project, including instruction to installation personnel.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver doors and frames palleted, or individually crated. Doors shall be side protected with surrounding grooved 2-inch (50.8 mm) by 4-inch (101.6 mm) wood frame and covered with 275-pound (124.74 kg) test corrugated cardboard.
- B. Inspect delivered doors and frames for damage; unload and store with minimum handling. Repair minor damage if refinished items are equal in all respects to new work; otherwise, remove damaged items and replace with new.
- C. Store products of this section under cover in manufacturer's unopened packaging until installation.
 - 1. Place units on minimum 4-inch (101.6 mm) wood blocking.
 - 2. Avoid non-vented plastic or canvas covers.
 - 3. Remove packaging immediately if packaging becomes wet.
 - 4. Provide 0.25-inch (6.35 mm) air spaces between stacked doors.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements of areas to receive aluminum frames; note discrepancies on submitted shop drawings.

1.08 SCHEDULING

- A. Ensure that all approvals and/or shop drawings are supplied or returned to the manufacturer in time for fabrication without affecting construction progress schedule.

- B. Ensure that actual hardware requested by manufacturer is available in time for fabrication without affecting construction progress schedule.

1.09 WARRANTY

- A. Manufacturer: Ten-year warranty against defects in workmanship and materials, including warping, rotting, decaying or bowing.
- B. Installer: Warrant installation procedures and performance for five years against defects due to workmanship and materials handling.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Model:
 - 1. Series 100BE
Cline Aluminum Doors, Inc.
112 32nd Avenue West, Bradenton, FL 34205-8907
Phone: (941) 746-4104, Fax: (941) 746-5153, Toll-free: (800) 648-6736
www.ClineDoors.com, Email: inquire@clinedoors.com
- B. Requests for substitution will be considered in accordance with provisions of Section 01 25 13

2.02 COMPONENTS

- A. Aluminum Members: Alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish.
- B. Flush Aluminum Door Composite Components: Minimum 5-ply composite laminated construction to include:
 - 1. Facing: One-piece 0.040-inch (1.02 mm) smooth 5005-H14 stretcher-leveled aluminum alloy.
 - 2. Substrate: One-piece 0.085-inch (2.16 mm) oil-tempered hardboard; neither pegboard nor non-tempered hardboard shall be accepted.
 - 3. Core: Pre-stabilized, five-pound minimum, EPS foam. No injected foams or poured-in-place foams acceptable to avoid air pockets and destabilization.
 - 4. Hardware Backup: Provide continuous, nonspecific hardware reinforcement with full internal perimeter aluminum tube, 4.25-inches (108 mm) in width, 0.125-inch (3.18 mm) minimum wall thickness.
 - 5. Bonding Agent: Shall be a commercial bonding adhesive with a strength buildup of 350 pounds per square inch (24.6 kg/cm²).
 - 6. Extrusion Wall: Thickness of 0.125-inch (3.18 mm) minimum, except beads and trim.

7. Beads and Trim: Wall Thickness of 0.050-inch (1.25 mm) minimum. Replaceable lock stile door edge of 6063-T5 extruded aluminum alloy with special beveled edge cap design shall be provided with integral weatherstripping. Hinge lock style to a clip mortise square edge design to accommodate standard weight and heavy weight butt hinges. Use of integral door edging not acceptable.
8. Weatherstripping: Replaceable wool pile with nylon fabric, polypropylene backing meeting AAMA 701 standards.
9. Materials: Only nonferrous, non-rusting members shall be acceptable, including tie rods, screws and reinforcement plates.
10. Regulations: All components and agents to meet EPA standards.

C. Aluminum Frames:

1. Frame Components: Extruded channel (tubular) 6063-T5 aluminum alloy, minimum wall thickness 0.125-inch (3.18 mm); cut corners square and joinery shall be mechanical with no exposed fasteners.
2. Profile: Open Back with Applied Stop (OBS), 1.75-inches by 5-inches (44 x 127 mm).
3. Hinge and Strike Mounting Plates: Extruded aluminum alloy bar stock, 0.1875-inch (4.75 mm) thick mounted in a concealed integral channel with no exposed fasteners.
4. Replaceable Weatherstripping: AAMA 701, wool pile with nylon fabric, polypropylene backing, at head and jambs.
5. Door Stop: No screw-on stops acceptable.
6. Frame Finish: Shall match door finish.

2.03 FINISH

- A. Finish: High Performance Organic Coating: Kynar/Polyvinylidene Fluoride (PVDF) (AAMA 605.2).
1. Color: Selected by Owner from manufacturer's standard colors.

2.04 FABRICATION

- A. General: Receive hardware if required by manufacturer.
- B. Aluminum Flush Door Construction: Of type, size and design indicated:
1. Minimum Thickness: 1.75-inches (44 mm), 5-ply composite laminate system. No 3-ply doors accepted for commercial application.
 2. Door Size: Sizes shown are nominal; provide standard clearances as follows:
 - a. Hinge and Lock Stiles: 0.125-inch (3.18 mm).
 - b. Between Meeting Stiles: 0.25-inch (6.35 mm).
At Top Rails: 0.125-inch (3.18 mm).

- c. Between Door Bottom and Threshold: 0.125-inch (3.18 mm).
 - 3. Face Panels: Exterior and interior aluminum panels shall be one-piece stretcher-leveled aluminum alloy, each laminated edge-to-edge to one-piece oil-tempered hardboard substrate.
 - 4. Substrate: Oil-tempered hardboard substrates shall have 100-percent bilateral lamination to a pre-stabilized, five-pound minimum, EPS foam core and internal hardware backup tube.
 - 5. Reinforcement: Internal tube shall reinforce the full internal door perimeter to allow for all specified and non-specified hardware.
 - 6. Core: Pre-stabilized, five-pound minimum, EPS foam core shall have 100-percent bilateral lamination to facing substrate and to internal reinforcement system.
 - 7. Door Edge: Door perimeter shall be trimmed with a field replaceable 6063-T5 extruded aluminum alloy, with a beveled edge on the lock stile and a clip mortise squares edged on the hinge stile, to protect door edges.
 - 8. Weatherstripping: Lock stile of door shall have wool pile weatherstripping applied.
- C. Aluminum Frames: Of shapes and contours indicated.
- 1. Corners shall be cut square.
 - 2. Reinforce and secure mechanically.

2.05 ACCESSORIES

- A. Fasteners: Aluminum, non-magnetic stainless steel, or other material warranted by manufacturer as non-corrosive and compatible with aluminum components.
 - 1. Do not use exposed fasteners.
- B. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible, otherwise, nonferrous stainless steel.
- C. Bituminous Coating: Cold-applied asphaltic mastic, compounded for 30-mil (0.76 mm) thickness per coat.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that wall surfaces and openings are ready to receive frames and are within tolerances specified in manufacturer's instructions.
- B. Verify that frames installed by other trades for installation of doors of this section are in strict accordance with recommendations and approved shop drawings and within tolerances specified in manufacturer's instructions.

3.02 PREPARATION

- A. Perform cutting, fitting, forming, drilling, and grinding of frames as required for project conditions; do not damage sight-exposed finishes.
- B. Separate dissimilar metals to prevent electrolytic action between metals.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and approved shop drawings; set frames plumb, square, level, and aligned to receive doors.
- B. Anchor frames to adjacent construction in strict accordance with recommendations and approved shop drawings and within tolerances specified in manufacturer's instructions.
 - 1. Seal metal-to-metal joints between framing members using good quality elastomeric sealant.
- C. Where aluminum surfaces contact with metals other than stainless steel, zinc or small areas of white bronze, protect from direct contact by one or more of the following methods.
 - 1. Paint dissimilar metal with one coat of heavy-bodied bituminous paint.
 - 2. Apply good quality elastomeric sealant between aluminum and dissimilar metal.
 - 3. Paint dissimilar metal with one coat of primer and one coat of paint recommended for aluminum surface applications.
 - 4. Use non-absorptive tape or gasket in permanently dry locations.
- D. Hang doors with required clearances as follows:
 - 1. Hinge and Lock Stiles: 0.125-inch (3.18 mm).
 - 2. Between Meeting Stiles: 0.250-inch (6.35 mm).
 - 3. At Top Rails: 0.125-inch (3.18 mm).
 - 4. Between Door Bottom and Threshold: 0.125-inch (3.18 mm).
- E. Adjust doors and hardware to operate properly.
- F. Install hardware for doors of this section.

3.04 CLEANING

- A. Upon completion of installation, thoroughly clean door and frame surfaces in accordance with AAMA 609.
- B. Do not use abrasive, caustic or acid cleaning agents.

3.05 PROTECTION

- A. Protect products of this section from damage caused by subsequent construction until substantial completion.
- B. Repair damaged or defective products to original specified condition in accordance with manufacturer's recommendations.
- C. Replace damaged or defective products that cannot be repaired to Owner's acceptance.

3.06 SCHEDULE

- A. Refer to Architectural Sheets

END OF SECTION

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Metal stud wall framing.
- B. Metal channel ceiling framing.
- C. Building insulation.
- D. Gypsum board.
- E. Taped and sanded joint treatment.

1.02 RELATED SECTIONS

- A. Section 09 90 00 - Painting.

1.03 SUBMITTALS

- A. Provide compliance with all listed standards.
- B. Provide certification of gypsum board paper facing recycled content.
- C. Certification of recycled content of gypsum board facing and metal framing materials.

1.04 REFERENCES

- A. ASTM C36 - Gypsum Wallboard.
- B. ASTM C79 - Gypsum Sheathing Board.
- C. ASTM C442 - Gypsum Backing Board and Core Board.
- D. ASTM C475 - Joint Treatment Materials for Gypsum Wallboard Construction.
- E. ASTM C557 - Adhesive for Fastening Gypsum Wallboard to Wood Framing.
- F. ASTM C645 - Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.
- G. ASTM C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

- H. ASTM C754 - Installation of Framing Members to Receive Screw Attached Gypsum Wallboard, Backing Board, or Water Resistant Backing Board.
- I. ASTM C840 - Application and Finishing of Gypsum Board.
- J. ASTM C1002 - Steel Drill Screws for the Application of Gypsum Board.
- K. ASTM E90 - Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
- L. GA-201 - Gypsum Board for Walls and Ceilings.
- M. GA-216 - Recommended Specifications for the Application and Finishing of Gypsum Board.

1.05 SYSTEM DESCRIPTION

- A. Metal stud and gypsum partition wall height as indicated on the drawings.
- B. Resilient channel and gypsum on CMU wall height as indicated on the drawings.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C840.

1.07 QUALIFICATIONS

- A. Applicator: Company specializing in performing the work of this section with minimum 5 years documented experience.

PART 2 - PRODUCTS

2.01 MANUFACTURERS - GYPSUM BOARD SYSTEM

- A. Manufacturers:
 - 1. Gold Bond.
 - 2. U.S.G.
 - 3. Georgia Pacific.
- B. Substitutions: Under provisions of Section 01 25 13 Substitution and Product Options

2.02 FRAMING MATERIALS

- A. Studs and Tracks: ASTM C645; GA-216 and GA-600; galvanized sheet steel, thick. C or SJ Shapes, 22 MSG studs, double 20 MSG at hinges, strikes and head

- B. Furring, Framing and Accessories: ASTM C645. GA-216 and GA-600.
- C. Fasteners: ASTM C1002.
- D. Anchorage to Substrate: Tie wire, nails, screws and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- E. Materials to be fabricated from 100% recycled content material with 80% post consumer content.

2.03 GYPSUM BOARD MATERIALS

- A. Standard Gypsum Board: ASTM C36; 5/8 inch thick, maximum permissible length; ends square cut, tapered edges.
- B. Moisture Resistant Gypsum Board: ASTM C630; 5/8 inch thick, maximum permissible length; ends square cut, tapered edges.
- C. Gypsum panels to have 100% post consumer recycled paper facing.

2.04 ACCESSORIES

- A. Building Insulation: ROCKWOOL Comfortbatt for Steel Stud; unfaced.
 - 1. R-Value: R-24
 - 2. Density: > 2 lbs/ft³ (>32 kg/m³) nominal.
 - 3. Surface Burning Characteristics: Tested in accordance with ASTM E84
 - (a) Unfaced: Flame Spread 0 and Smoke Developed 0
 - 4. Moisture Resistance: Absorption of less than 0.03 percent by volume, when tested in accordance with ASTM C1104.
 - 5. Corrosion Resistance: Non-corrosive/Passed, when tested in accordance with ASTM C665 for Steel & ASTM C795 for Stress Corrosion Cracking Tendency of Austenitic Stainless Steel.
 - 6. Fungi resistance: Zero mold growth to ASTM C1338
- B. Corner Beads: Metal.
- C. Edge Trim: GA 201 and GA 216; Type L bead.
- D. Joint Materials: ASTM C475; GA 201 and GA 216; reinforcing tape, joint compound, adhesive, and water.
- E. Fasteners: ASTM C1002, Type S12.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that site conditions are ready to receive work and opening dimensions are as indicated on shop drawings.

3.02 METAL STUD INSTALLATION

- A. Install studs in accordance with ASTM C754. GA-201, GA-216 and GA-600.
- B. Refer to Drawings for indication of partitions extending to finished ceiling only and for partitions extending through the ceiling to the structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
- C. Door Opening Framing: Install double studs at door frame jambs.
- D. Install latex sealant as specified in 07 90 00 at gypsum board perimeter.
 - 1. Seal all penetrations by conduit, pipe, duct work, or rough-in boxes.

3.03 GYPSUM BOARD INSTALLATION

- A. Install gypsum board in accordance with GA-201, GA-216 and GA-600.
- B. Erect single layer standard gypsum board horizontally with ends and edges occurring over firm bearing.
- C. Use screws when fastening gypsum board to metal furring or framing.
- D. Place control joints consistent with lines of building spaces.
- E. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.
- F. Install insulation as indicated on the drawings as recommended by the manufacturer.

3.04 JOINT TREATMENT

- A. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
- B. Feather coats onto adjoining surfaces so that camber is maximum 1/32 inch.

3.05 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 65 10 RESILIENT TILE FLOORING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Vinyl composition floor tile.
- B. Related Sections include the following:
 - 1. Section 09653, Resilient Wall Base and Accessories for resilient wall base, reducer strips, and other accessories installed with resilient floor tiles.

1.03 SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors and patterns available for each type of product indicated.
- C. Product Certificates: Signed by manufacturers of resilient products certifying that each product furnished complies with requirements.
- D. Maintenance Data: For resilient floor tile to include in the maintenance manuals specified in Division 1.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.
- B. Source Limitations: Obtain each type, color and pattern of product specified from one (1) source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E 648.
2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 °F (10 and 32 °C).
- C. Store tiles on flat surfaces.
- D. Move products into spaces where they will be installed at least forty-eight (48) hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.06 PROJECT CONDITIONS

- A. Maintain a temperature of not less than 70 °F (21 deg C) or more than 95 °F (35 deg C) in spaces to receive products for at least forty-eight (48) hours before installation, during installation, and for at least forty-eight (48) hours after installation, unless manufacturer's written recommendations specify longer time periods. After post installation period, maintain a temperature of not less than 55 °F (13 °C) or more than 95 °F (35 °C).
- B. Do not install products until they are at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.
- D. Install tiles and accessories after other finishing operations, including painting, have been completed.
- E. Where demountable partitions and other items are indicated for installation on top of resilient tile flooring, install tile before these items are installed.
- F. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by flooring manufacturer's recommended bond and moisture test.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Furnish not less than one (1) box for each fifty (50) boxes or fraction thereof, of each type, color, pattern, class, wearing surface and size of resilient tile flooring installed.
2. Deliver extra materials to Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the Resilient Tile Flooring Schedule at the end of Part 3.

2.02 RESILIENT TILE

- A. Vinyl Composition Floor Tile: Products complying with ASTM F 1066 and with requirements specified in the Resilient Tile Flooring Schedule.

2.03 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 1. Slab substrates are dry and free of curing compounds, sealers, hardeners and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer.
 2. Subfloor finishes comply with requirements specified in Section 03300, Cast-in-Place Concrete for slabs receiving resilient flooring.
 3. Subfloors are free of cracks, ridges, depressions, scale and foreign deposits.

- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. General: Comply with resilient product manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.03 TILE INSTALLATION

- A. General: Comply with tile manufacturer's written installation instructions.
- B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half ($\frac{1}{2}$) of a tile at perimeter.
 - 1. Lay tiles square with room axis, unless otherwise indicated.
- C. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped or deformed tiles.
 - 1. Lay tiles in basket-weave pattern with grain direction alternating in adjacent tiles.
- D. Scribe, cut and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames and thresholds.
- E. Extend tiles into toe spaces, door reveals, closets and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent, non-staining marking device.
- G. Install tiles on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces

of flooring installed on covers. Tightly fit the tile edges to the floor around covers and to covers.

- H. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to comply with tile manufacturer's written instructions, including those for trowel notching, adhesive mixing and adhesive open and working times.
 - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Hand roll tiles according to tile manufacturer's written instructions.

3.04 RESILIENT ACCESSORY INSTALLATION

- A. General: Install resilient accessories according to manufacturer's written installation instructions.
- B. Place resilient accessories so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.
- C. Apply resilient products to stairs as indicated and according to manufacturer's written installation instructions.

3.05 CLEANING AND PROTECTING VINYL COMPOSITION TILE

- A. Immediately after completing tile installation clean and protect tiles as follows and using methods recommended by manufacturer:
 - 1. Remove visible adhesive and other surface blemishes using cleaner recommended by tile manufacturers.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Wash floor (minimum four (4) days after installation). Damp mop with a diluted neutral detergent solution. Use mineral spirits (painter's naphtha) to remove stubborn dirt or adhesive residue. Do not scrub floor with floor machine or apply liberal amount of cleaner or water for minimum one (1) week after installation.
 - 4. Apply two (2) coats of high quality metal cross-linked acrylic floor polish.
- B. Protect flooring against mars, marks, indentations and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by tile manufacturer.
 - 1. Do not move heavy and sharp objects directly over tiles. Place plywood or hardboard panels over tiles and under objects while they are being moved. Slide or roll objects over panels without moving panels.

- C. Not more than four (4) days prior to dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project clean tiles as follows and using methods recommended by manufacturer.
 - 1. Scrub floor using a good quality neutral cleaner and single disc floor machine equipped with scrubbing pad or soft scrubbing brush. Stripping of initial protective polish is not necessary unless floor was subjected to harsh abusive traffic. If necessary, clean floor with a stripping solution recommended by the polish manufacturer to remove ground-in dirt. Pick up cleaner or stripping solution with a vacuum recommended for this use.
 - 2. Rinse thoroughly after scrubbing or stripping. Allow to dry thoroughly.
 - 3. When dry, apply four (4) coats of a good quality metal cross-linked acrylic floor polish. Sealers are permissible if specified by the polish manufacturer's maintenance system. Apply coats of polish as recommended by the manufacturer and protect from traffic for a minimum of four (4) hours. Overnight drying is best.

3.06 CLEANING AND PROTECTING RUBBER FLOOR TILE AND ACCESSORIES

- A. Perform the following operations immediately after installing resilient products:
 - 1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Do not wash floor until after time period recommended by flooring manufacturer.
 - 4. Damp-mop floor to remove marks and soil.
- B. Protect flooring against mars, marks, indentations and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.
 - 1. Cover products installed on floor surfaces with un-dyed, untreated building paper until inspection for Substantial Completion.
 - 2. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.
- C. Clean floor surfaces not more than four (4) days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.

3.07 RESILIENT TILE FLOORING SCHEDULE

- A Vinyl Composition Tile: Where the following designation is listed in the Room Finish Schedule on Drawing A-3.9, provide vinyl composition floor tile complying with the following:

City of Clearwater

**NE WRF MCC-1, DC1 & 2 REPLACEMENT
17-0028-UT
00992-0254**

***Resilient Tile Flooring
09 65 10-6***

1. VCT-1

a. Available Products: As follows:

- 1) Armstrong World Industries, Inc
- 2) Azrock Industries, Inc.
- 3) Mannington, Inc., Mannington Commercial
- 4) Tarkett, Inc.
 - (a) Color and Pattern: As selected by Architect from manufacturer's full range of colors and patterns produced for tile complying with requirements indicated.
 - (b) Class: Class 2 (through-pattern tile).
 - (c) Wearing Surface: Smooth.
 - (d) Thickness: 1/8 inch (3.2 mm).
 - (e) Size: 12 by 12 inches (304.8 by 304.8 mm).

2. VCT-2

a. Available Products: As follows:

- 1) Armstrong World Industries, Inc
- 2) Azrock Industries, Inc.
- 3) Mannington, Inc., Mannington Commercial
- 4) Tarkett, Inc.
 - (f) Color and Pattern: As selected by Architect from manufacturer's full range of colors and patterns produced for tile complying with requirements indicated.
 - (g) Class: Class 1 (solid color).
 - (h) Wearing Surface: Smooth.
 - (i) Thickness: 1/8 inch (3.2 mm).
 - (j) Size: 6 by 24 inches (15.25 cm by 60.96 cm).

END OF SECTION

SECTION 09 69 00 ACCESS FLOORING

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Work of this section includes, but is not limited to access floor panels, floor coverings, understructure and various electrical, data and communication accessories.

1.02 Related Sections

- A. Concrete sealer shall be compatible with pedestal adhesive, see Division 3.
- B. See Division 26 Section “Grounding and Bonding for Electrical Systems” for connection to ground of access flooring understructure. Note: The electrical engineer or contractor shall determine requirements for grounding and the electrical contractor shall provide the necessary labor and materials to electrically connect the access flooring to the building ground if it is required.

1.03 Environmental Conditions for Storage and Installation

- A. Area to receive and store access floor materials shall be enclosed and maintained at ambient temperatures between 35° to 95° F and relative humidity levels between 20% to 80%. All floor panels shall be stored at ambient temperature between 50° to 90° F for at least 24 hours before installation begins. All areas of installation shall be enclosed and maintained at ambient temperature between 50° to 90° F and at relative humidity levels between 20% to 80% and shall remain within these environmental limits throughout occupancy.

1.04 References

- B. CISCA (Ceilings & Interior Systems Construction Association) - “Recommended Test Procedures for Access Floors” shall be used as a guideline when presenting load performance product information.

1.05 Performance Certification

- A. Product tests shall be witnessed and certified by independent engineering and testing laboratory based in the U.S. with a minimum of five years experience testing access floor components in accordance CISCA “Recommended Test Procedures for Access Floors”.

1.06 Performance Requirements

- A. Design Load: Panel supported on actual understructure system shall be capable of supporting a point load of 1000 lbs. applied on a one square inch area at any location on the panel without experiencing permanent set in excess of 0.010 inches as defined by CISCA. The loading method used to determine design

(allowable) load shall be in conformance with CISCA Concentrated Load test method but with panel tested on actual understructure instead of steel blocks.

- B. Safety Factor: Panel supported on actual understructure system shall withstand a point load of no less than (2) two times its design load rating on a one square inch area anywhere on the panel without failure when tested in accordance with CISCA A/F, Section 2, "Ultimate Loading". Failure is defined as the point at which the system will no longer accept the load.
- C. Ultimate Load: Panel supported on actual understructure system shall be capable of supporting a point load of at least 2000 lbs. applied through a load indenter on a one square inch area at any location on the panel without failure (i.e. minimum safety factor if 2) when tested in accordance with CISCA A/F, Section 2, "Ultimate Loading".
- D. Rolling Load: Panel supported on actual understructure system shall be able to withstand the following rolling loads at any location on the panel without developing a local and overall surface deformation greater than 0.040 inches when tested in accordance with CISCA A/F Section 3, "Rolling Loads". Note: wheel 1 and wheel 2 tests shall be performed on two separate panels.

CISCA Wheel 1: Size: 3" dia x 1 13/16" wide Load: 800 lbs. Passes: 10
CISCA Wheel 2: Size: 6" dia x 2" wide Load: 600 lbs. Passes: 10,000
- E. Impact Load: Panel and supporting understructure (the system) shall be capable of supporting an impact load of 150 lbs. dropped from a height of 36 inches onto a one square inch area (using a round or square indenter) at any location on the panel when tested in accordance with CISCA A/F, Section 8, "Drop Impact Load Test".
- F. Panel Cutout: Panel with an 8.625" diameter interior cutout shall be capable of withstanding an ultimate load of 2000 lbs. without failure without the use of additional supports.
- G. Flammability: Panel shall meet *Class A* Flame spread requirements for flame spread and smoke development. Tests shall be performed in accordance with ASTM-E84-1998, Standard Test Method for Surface Burning Characteristics for Building Materials.
- H. Combustibility: Panel shall qualify as non-combustible by demonstrating compliance with requirements of ASTM E 136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 deg C.
- I. Recycled Content: Panel and understructure system shall be required to have a minimum post-consumer recycled content of 18% and a minimum total recycled content of 49%.
- J. Axial Load: Pedestal support assembly shall provide a 6000 lb. axial load without permanent deformation when tested in accordance with CISCA A/F, Section 5, "Pedestal Axial Load Test".

- K. Overturning Moment: Pedestal support assembly shall provide an average overturning moment of 1000 in-lbs. when glued to a clean, sound, uncoated concrete surface when tested in accordance with CISCA A/F, Section 6, "Pedestal Overturning Moment Test".
- L. Stringer Concentrated Load: Stringer shall be capable of withstanding a concentrated load of 450 lbs. placed in its midspan on a one square inch area using a round or square indenter without exceeding a permanent set of 0.010" after the load is removed when tested in accordance with CISCA A/F, Section 4, "Stringer Load Testing".

1.07 DESIGN REQUIREMENTS

- A. Access floor system, where indicated on the design documents, shall consist of modular and removable fully encased cementitious filled welded steel panels supported on all four edges by structural steel members which are designed to bolt onto adjustable height pedestal assemblies forming a modular grid pattern.
- B. Panel shall be easily removed by one person with a suction cup lifting device and shall be interchangeable except where cut for special conditions.
- C. Quantities, finished floor heights (FFH), and location of accessories shall be as specified on the contract drawings.

1.08 SUBMITTALS FOR REVIEW

- A. Detail sheets, for each proposed product type, which provide the necessary information to describe the product and its performance.
- B. Test reports, certified by an independent testing laboratory with a minimum of five years experience testing access floor components in accordance with CISCA Recommended Test Procedures, certifying that component parts perform as specified.

1.09 SUBMITTALS FOR INFORMATION

- A. Manufacturer's installation instructions and guidelines.
- B. Manufacturer's Owner Manual outlining recommended care and maintenance procedures.

PART 2 – PRODUCTS

2.01 Manufacturers

- A. Access floor system shall be as manufactured by Tate Access Floors, Inc. and shall consist of ConCore® 1000 access floor panel supported by an LFFH bolted stringer understructure system.

- B. Alternative products shall meet or exceed all requirements as indicated herein and must receive prior written approval by the architect.
- C. Access floor manufacture shall be ISO9001: 2015 certified demonstrating it has a robust and well documented quality management system with continuous improvement goals and strategies.
- D. Access floor manufacturer's facilities shall be ISO14001:2015 certified demonstrating that they maintain an environmental management system.
- E. Access floor manufacturer's facilities shall be OHSAS 18001:2018 certified demonstrating that they maintain an Occupational Health and Safety Management system.

2.02 Support Components

Pedestals:

- A. Pedestal assemblies shall be corrosive resistant, all steel construction. Zinc electroplating shall be prohibited on all pedestal components, including head plate, threaded rod, base plate, and all fasteners.
- B. Pedestal assembly for a 4" FFH system shall have an adjustment range of +/- 1/2".
- C. Pedestal assembly for a 3" FFH system shall have an adjustment range of +1/2" - 1/8".
- D. Pedestal assemblies shall provide a means of leveling the assembly at a selected height.
- E. Hot dip galvanized steel pedestal head shall have a threaded core to accept a 3/4"-10 stud for height adjustment.
- F. Hot dip galvanized pedestal base assembly shall consist of a formed steel plate with no less than 16 inches of bearing area, resistance welded to a 3/4"-10 steel stud.

Stringers:

- A. Stringers shall support each edge of panel.
- B. Steel stringer shall have conductive galvanized coating. Zinc electroplating shall be prohibited on stringers and stringer fasteners.
- C. Stringers shall be individually and rigidly fastened to the pedestal with one machine screw for each foot of stringer length. Bolts shall provide positive electrical contact between the stringers and pedestals. Connections depending on gravity or spring action are unacceptable.

- D. Stringer grid shall be 2' x 2'.

2.03 PANEL COMPONENTS

Floor Panels:

- A. Panels shall consist of a top steel sheet welded to a formed steel bottom pan filled internally with a lightweight cementitious material. Mechanical or adhesive methods for attachment of the steel top and bottom sheets are unacceptable.
- B. Floor panels shall be protected from corrosion by electro-deposited epoxy paint. The use of zinc electroplating shall be prohibited.
- C. Cementitious fill material shall be totally encased within the steel welded shell except where cut for special conditions. Note: This greatly reduces the potential for dust in the environment from exposed cement materials.
- D. Top surface of the panel shall have an option for four positioning location holes to engage positioning buttons on the PosiTile® carpet tile for precise matching of the carpet tile to the panel (combination Bolted Stringer/Cornerlock system only).

2.04 ACCESSORIES

- A. Provide manufacturer's standard steps, ramps, fascia plate, perimeter support, and grommets where indicated on the contract drawings.
- B. Provide 6 spare floor panels and 24 square feet of understructure systems for each type used in the project for maintenance stock. Deliver to project in manufacturer's standard packaging clearly marked with the contents.
- C. Provide 2 panel lifting devices.

2.05 FINISHES

- A. Finish the surface of floor panels with floor covering material as indicated on the contract drawings. Where floor coverings are by the access floor manufacturer, the type, color and pattern shall be selected from manufacturer's standard. All areas to be furnished with laminated floor panels must be maintained at ambient temperature between 50° to 90° F and at humidity level between 20% to 80% relative and shall remain within these ranges through installation and occupancy.
- B. Carpet tile: Access floor system shall be designed to accommodate modular carpet tiles (PosiTile®) that precisely match with ConCore® panels in a one-to-one configuration. This is accomplished by four positioning buttons on the carpet tile which engage into button location holes in the floor panel. The carpet tile's backing maintains dimensional stability and holds the carpet tile flat without field application of adhesive. Adhesives shall not be required on the PosiTile installation except where a carpet tile is cut, and more than two positioning buttons are removed.

- C. Freelay resilient tile or freelay Luxury Vinyl Tile (LVT) planks: Rigid underlayment (by others) must be installed over the access floor prior to installing freelay tile or planks.

2.06 Fabrication Tolerances

- A. Floor panel flatness measured on a diagonal: +/- 0.035"
- B. Floor panel flatness measured along edges: +/- 0.025"
- C. Floor panel width or length of required size: +/- 0.010"
- D. Floor panel squareness tolerance: +/- 0.015"

PART 3 – EXECUTION

3.01 Preparation

- A. Examine structural subfloor for unevenness, irregularities and dampness that would affect the quality and execution of the work. Do not proceed with installation until structural floor surfaces are level, clean, and dry as completed by others.
- B. Concrete sealers, if used, shall be identified and proven to be compatible with pedestal adhesive. Verify that adhesive achieves bond to slab before commencing work.
- C. Verify dimensions on contract drawings, including level of interfaces including abutting floor, ledges and doorsills.
- D. The General Contractor shall provide clear access, dry subfloor area free of construction debris and other trades throughout installation of access floor system.
- E. Area to receive and store access floor materials shall be enclosed and maintained at ambient temperatures between 35° to 95° F and relative humidity levels between 20 to 80%. At least 24 hrs. before installation begins, all floor panels shall be stored at ambient temperatures between 50° to 90° F and relative humidity levels between 20% to 80% and shall remain within these environmental limits throughout occupancy.

3.02 INSTALLATION

- A. Pedestal locations shall be established from approved shop drawings so that mechanical and electrical work can be installed without interfering with pedestal installation.
- B. Installation of access floor shall be coordinated with other trades to maintain the integrity of the installed system. All traffic on access floor shall be controlled by access floor installer. No traffic but that of access floor installers shall be permitted on any floor area for 24 hours to allow the pedestal adhesive to set.

Access floor panels shall not be removed by other trades for 72 hours after their installation.

- C. Floor system and accessories shall be installed under the supervision of the manufacturer's authorized representative and according to manufacturer's recommendations.
- D. No dust or debris producing operations by other trades shall be allowed in areas where access floor is being installed to ensure proper bonding of pedestals to subfloor.
- E. Access floor installer shall keep the subfloor broom clean as installation progresses.
- F. Partially complete floors shall be braced against shifting to maintain the integrity of the installed system where required.
- G. Additional pedestals as needed shall support panels where floor is disrupted by columns, walls, and cutouts.
- H. Understructure shall be aligned such that all uncut panels are interchangeable and fit snugly but do not bind when placed in alternate positions.
- I. Finished floor shall be level, not varying more than 0.062" in 10 feet or 0.125" overall.
- J. Inspect system prior to application of floor covering and replace any floor panels that are cracked, broken and structurally damaged and do not comply with specified requirements.
- K. Acceptance: General contractor shall accept floor in whole or in part prior to allowing use by other trades.

END OF SECTION

SECTION 09 90 00 PAINTING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, tools, materials, equipment, scaffolding or other structures and incidentals necessary to complete this Contract in its entirety.
- B. The work includes painting and finishing of all new interior and exterior exposed items above and below grade and surfaces, such as structural steel, miscellaneous metals, ceilings, walls, floors, doors, frames, transoms, roof fans, construction signs, guardrails, posts, fittings, valves, tanks, equipment and all other work obviously required to be painted unless otherwise specified herein or on the Drawings. The omission of minor items in the Schedule of Work shall not relieve the Contractor of his obligation to include such items where they come within the general intent of the Specification as stated herein.
- C. The following items shall not be painted:
 - 1. Any code-requiring labels, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.
 - 2. Any moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts, unless otherwise indicated.
 - 3. Aluminum handrails (except where in contact with concrete) walkways, windows, louvers and grating unless otherwise specified herein.
 - 4. Signs and nameplates.
 - 5. Finish hardware.
 - 6. Chain link fence.
 - 7. Piping buried in the ground or embedded in concrete.
 - 8. Concealed surfaces of pipe or crawl space.
 - 9. Nonferrous metals, unless specifically noted otherwise.
 - 10. Electrical switchgear and motor control centers.
 - 11. Stainless steel angles, tubes, pipe, etc.
 - 12. Products with polished chrome, aluminum, nickel or stainless steel finish.
 - 13. Plastic switch plates and receptacle plates.
 - 14. Flexible couplings, lubricated bearing surfaces, insulation and metal and plastic pipe interior.
 - 15. Sprinkler heads.
 - 16. Lifting chain on cranes and hoists
 - 17. Electrical cable, festooned conductor system, cables, collector pole brackets, etc.
- D. All work shall be done in strict accordance with this Specification, the Design Drawings and the painting package, including manufacturer's printed instructions.

The Contractor will obtain, at its own expense, all permits, licenses and inspections and shall comply with all laws, codes, ordinances, rules and regulations promulgated by authorities having jurisdiction which may bear on the Work. This compliance will include Federal Public Law 91-596 more commonly known as the "Occupational Safety and Health Act of 1970".

1.02 DEFINITIONS

- A. Field Painting is the painting of new or rebuilt items at the job site. Field painting shall be the responsibility of the Contractor.
- B. Shop Painting is the painting of new or rebuilt items in the shop prior to delivery to the jobsite.
- C. Abbreviations The abbreviations and definitions listed below, when used in this specification, shall have the following meanings:
 - 1. Owner – The term owner is used to refer to either the owner or an appointed owner’s representative such as an engineer, architect, etc.
 - 2. SSPC - The Society for Protective Coatings
 - 3. Exterior - Outside, exposed to weather
 - 4. Interior Dry - Inside, concealed or protected from weather
 - 5. Interior Wet - Inside, subject to immersion services
 - 6. ASTM - American Society of Test Materials
 - 7. NACE - National Association of Corrosion Engineers
 - 8. NSF - National Sanitation Foundation
 - 9. AWWA - American Water Works Association
 - 10. ICRI - International Concrete Restoration Institute
 - 11. NAPF – National Association of Pipe Fitters
 - 12. Dry Film Thickness shall be in Mils

1.03 RESOLUTION OF CONFLICTS

- A. It shall be the responsibility of the Contractor to arrange a meeting prior to the start of any coatings applications between the Contractor, the Coating Manufacturer, whose products are to be used, and the Owner. All aspects of surface preparation, application and coating systems as covered by this Specification will be reviewed at this meeting.
- B. Clarification shall be requested promptly from the Owner when instructions are lacking, conflicts occur in the Specifications, or the procedure seems improper or inappropriate for any reason.
- C. Copies of all manufacturer's instructions and recommendations shall be furnished to the Owner by the Painting Contractor.
- D. It shall be the responsibility of the Coating Manufacturer to have their representative meet in person with the Contractor and Owner before and during

the job as a consultant on proper preparation and application of the coating materials unless a meeting is determined to be unnecessary by the Owner.

1.04 SUBMITTALS

- A. Contractor shall submit catalog data and cut sheets for the painting system being used if not the TNEMEC materials specified.
- B. Samples as detailed in 3.01 B shall be submitted regardless of system being used, showing each color to be used.
- C. Hazardous Material Disposal documentation shall be submitted if applicable.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. Effective oil and water separators shall be used in all compressed air lines serving spray painting and sandblasting operations to remove oil or moisture from the air before it is used. Separators shall be placed as far as practicable from the compressor.
- B. All equipment for application of the paint and the completion of the work shall be furnished by the Contractor in first-class condition and shall comply with recommendations of the paint manufacturer.
- C. Contractor will make available to the Owner a "Nordson-Mikrotest" or "Positest" dry film thickness gauge for ferrous metal and an OG232 "Tooke" gauge or equal for non-ferrous and cementitious surface, to be used to inspect coatings by the Owner and Contractor.

2.02 MATERIALS

- A. All materials specified herein are manufactured by the TNEMEC Company, Inc., North Kansas City, Missouri. These products are specified to establish standards of quality and are approved for use on this Project.
- B. The specified basis of design is intended to provide the longest service life possible, lowest life cycle cost and most sustainable solution. All Contractors must provide pricing based on the basis of design. If submitting alternate products, this must be shown in the Bid Schedule as an ADD or DEDUCT to the overall Base Bid, so the Owner can decide which coating system to accept.
- C. Equivalent materials of other manufacturers may be substituted on approval of the Owner. Requests for substitution must include a side-by-side comparison of equality, including: manufacturer's literature for each product giving the name, generic type, volume solids, descriptive information, evidence of satisfactory past performance, and an independent laboratory certification that their product meets the performance criteria of the specified materials.

- D. To allow time for review, all requests for substitution shall be submitted by the coating manufacturer a minimum of 10 days prior to the project bid date.
- E. Substitutions which decrease the total film thickness, change the generic type of coating, or fail to meet the performance criteria of the specified materials shall not be approved. Substitutions which otherwise reduce performance shall not be approved.
- F. Prime and finish coats of all surfaces shall be furnished by the same manufacturer.
- G. All coatings to be shop applied must meet the requirements for volatile organic compounds (VOC) of not more than 3.5 lbs/gallon after thinning.
- H. Colors, where not specified, shall be as selected by the Owner or their Representative.
- I. All coatings in contact with potable water need to be NSF Certified, Tested, and Listed in accordance with ANSI/NSF Standard 61.
- J. All above ground potable water mains and appurtenances shall be painted Safety Blue (Tnemec 11SF).

2.03 REFERENCES

- A. This section contains references to the governing standards and documents listed below. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the more stringent of the requirements shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of receipt of Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.
- C. Referenced publications found within this specification shall be the latest revision unless otherwise specified; and applicable parts of the referenced publications shall become a part of this specification as if fully included.
- D. ASTM International (ASTM):
 1. ASTM B117 – Salt Spray (Fog)
 2. ASTM C140 – Water Absorption (Applied to Cast Mortar Cubes)
 3. ASTM C307 – Tensile Strength, Elongation, Modulus of Elasticity
 4. ASTM C531 – Thermal Expansion

5. ASTM C579 – Compressive Strength
 6. ASTM C580 – Flexural Strength and Modulus of Elasticity
 7. ASTM C67 – Water Absorption (Applied to Fire Clay Brick)
 8. ASTM C793 – Accelerated Weathering
 9. ASTM C97 – Water Absorption (Applied to Ohio Sandstone)
 10. ASTM D1014 – Exterior Exposure
 11. ASTM D2047 – Coefficient of Friction
 12. ASTM D2240 - Hardness
 13. ASTM D2247 - Humidity
 14. ASTM D2370 – Tensile Strength, Elongation, Modulus of Elasticity
 15. ASTM D2794 - Impact
 16. ASTM D3273 – Fungal/Mold/Mildew Resistance
 17. ASTM D4060 - Abrasion
 18. ASTM D4141, Method C (EMMAQUA) – Exterior Exposure
 19. ASTM D4541 – Adhesion
 20. ASTM D4585 – Humidity
 21. ASTM D4587 – QUV Exposure
 22. ASTM D522 – Flexibility and Elongation
 23. ASTM D5590 – Fungal/Mold/Mildew/Algal Resistance
 24. ASTM D5894 – Cyclic Salt Fog/UV Exposure
 25. ASTM D624 – Tear Strength
 26. ASTM D638 – Tensile Strength, Elongation, Modulus of Elasticity
 27. ASTM D648 – Deflection Temperature
 28. ASTM D6695 – Xenon Arc Weathering
 29. ASTM D695 – Compressive Strength
 30. ASTM D7234 - Adhesion
 31. ASTM D790 – Flexural Strength and Modulus of Elasticity
 32. ASTM D870 – Immersion
 33. ASTM G85 – Prohesion
- E. NACE International (NACE):
1. NACE TM-01-74
- F. Federal Specification (FED):
1. FED TT-C-555B - Wind Driven Rain
- G. Military and Government Specs & Standards:
1. MIL D3134 – Impact
- H. British Standard:
1. BS EN 598: 2007+A1: 2009 - Rocking Abrasion
- I. American Association of State Highway and Transportation Officials
1. AASHTO T-259 – Chloride Ion Penetration

PART 3 EXECUTION

3.01 INSPECTION OF SURFACES

- A. Before application of the prime coat and each succeeding coat, all surfaces to be coated shall be subject to inspection by the Owner. Any defects or deficiencies shall be corrected by the Contractor before application of any subsequent coating.
- B. Samples of surface preparation and of painting systems shall be furnished by the Contractor to be used as a standard throughout the job, unless omitted by the Owner.
- C. The Contractor shall follow the Manufacturer's latest printed recommended minimum and maximum recoat times. If the maximum recoat time has been exceeded, the Contractor shall follow the Manufacturer's latest printed instructions.
- D. Coating thickness shall be determined by the use of a properly calibrated "Nordson-Mikrotest" or "Positest" Coating Thickness Gauge (or equal) for ferrous metal. Please note that a "Tooke" gauge may be used on cementitious surfaces, and that use of the "Tooke" gauge is classified as a destructive test.
- E. Before performing any destructive tests on a newly applied coating system, the Owner and Contractor shall determine which of them is responsible for the cost of repairing the damaged coatings.

3.02 STANDARDS FOR SURFACE PREPARATION

- A. SSPC-SP1: Solvent Cleaning: Remove all grease, oil, salt, acid, alkali, dirt, dust, wax, fat, foreign matter and contaminates, etc. by one of the following methods: steam cleaning, alkaline cleaning, or volatile solvent cleaning.
- B. SSPC-SP2: Hand Tool Cleaning: Removal of loose rust, loose mill scale and loose paint to a clean sound substrate by hand chipping, scraping, sanding and wire brushing.
- C. SSPC-SP3: Power Tool Cleaning: Removal of loose rust, loose mill scale and loose paint to a clean sound substrate by power tool chipping, descaling, sanding, wire brushing and grinding.
- D. SSPC-SP5/NACE No.1: White Metal Blast Cleaning: Complete removal of all mill scale, rust, rust scale, previous coating, etc., leaving the surface a uniform gray-white color.
- E. SSPC-SP6/NACE No.3: Commercial Blast Cleaning: Complete removal of all dirt, rust scale, mill scale, foreign matter and previous coating, etc., leaving only shadows and/or streaks caused by rust stain and mill scale oxides. At least 66% of each square inch of surface area is to be free of all visible residues, except

slight discoloration.

- F. SSPC-SP7/NACE No.4: Brush-Off Blast Cleaning: Removal of rust scale, loose mill scale, loose rust and loose coatings, leaving tightly-bonded mill scale, rust and previous coatings. On concrete surfaces, brush-off blast cleaning shall remove all laitance, form oils and solid contaminants. Blasting should be performed sufficiently close to the surface so as to open up surface voids, bugholes, air pockets and other subsurface irregularities, but so as not to expose underlying aggregate.
- G. SSPC-SP10/NACE No.2: Near-White Blast Cleaning: Removal of all rust scale, mill scale, previous coating, etc., leaving only light stains from rust, mill scale and small specks of previous coating. At least 95% of each square inch of surface area is to be free of all visible residues and the remainder shall be limited to slight discoloration.
- H. SSPC-SP11: Power Tool Cleaning to Bare Metal: Complete removal of rust, rust scale, mill scale, foreign matter and previous coatings, etc., to a standard as specified on a Commercial Grade Blast Cleaning (SSPC-SP-6, NACE-3) by means of power tools that will provide the proper degree of cleaning and surface profile.
- I. SSPC-SP13/NACE No.6: Surface Preparation of Concrete: Provides requirements for surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems.
 - a. International Concrete Restoration Institute (ICRI):
 - 1. ICRI 310.1R - Exposed Reinforcing bar (Rebar) Repair
 - 2. ICRI-CSP 1 - Concrete Surface Profile 1
 - 3. ICRI-CSP 2 - Concrete Surface Profile 2
 - 4. ICRI-CSP 3 - Concrete Surface Profile 3
 - 5. ICRI-CSP 4 - Concrete Surface Profile 4
 - 6. ICRI-CSP 5 - Concrete Surface Profile 5
 - 7. ICRI-CSP 6 - Concrete Surface Profile 6
- J. SSPC-SP14/NACE No.8: Industrial Blast Cleaning: An industrial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dust, and dirt. Traces of tightly adherent mill scale, rust, and coating residues are permitted to remain on 10% of each unit area of the surface if they are evenly distributed.
- K. SSPC-SP15: Commercial Grade Power Tool Cleaning: A commercial grade power tool cleaned steel surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, rust, coating, oxides, mill scale, corrosion products, and other foreign matter, except as noted. Random staining shall be limited to no more than 33 percent of each unit area of surface as defined.

- L. Visual standards "Pictorial Surface Preparation Standards for Painting Steel Surfaces", and the National Association of Corrosion Engineer, "Blasting Cleaning Visual Standards" TM-01-70 and TM-01-75 shall be considered as standards for proper surface preparation.
- M. NAPF 500-03-04: External Pipe Surface: When viewed without magnification, the exterior surfaces shall be free of all visible dirt, dust, loose annealing oxide, rust, mold, coatings, and other foreign matter.
- N. NAPF 500-03-05: Fitting Blast Clean #2: When viewed without magnification, no more than 5% staining may remain on the surface and the exterior surfaces shall be free of all visible dirt, dust, annealing oxide, rust, mold, coatings, and other foreign matter.

3.03 SURFACE PREPARATION

- A. The surface shall be cleaned as specified for the paint system being used.
- B. All cleaning shall be as outlined in the Society for Protective Coatings (SSPC) Surface Preparation Specification, National Association of Corrosion Engineers (NACE), and the International Concrete Repair Institute (ICRI) unless otherwise noted.
- C. If surfaces are subject to contamination, other than mill scale or normal atmospheric rusting, the surfaces shall be checked for chloride contamination, pressure washed, and acid or caustic pH residues neutralized, in addition to the specified surface preparation.
- D. All bare concrete surfaces exposed to wastewater or similar corrosive atmospheres shall be confirmed to have a minimum pH of 9 prior to the application of coatings.
- E. Oil, grease, soil, dust, etc., deposited on the surface after preparation has been completed shall be removed prior to painting in accordance with SSPC-SP1 Solvent Cleaning.
- F. Weld flux, weld spatter, and rust scale shall be removed by a minimum of SSPC-SP3 Power Tool Cleaning as per these Specifications.
- G. All weld seams, sharp protrusions and edges shall be ground smooth prior to surface preparation or application of any coatings.
- H. All areas requiring field welding shall be masked off prior to shop coating, unless waived by the Owner.
- I. All areas which require field touch-up after erection, such as welds, burnbacks, and mechanically damaged areas, shall be prepared per the Manufacturer's latest written recommendations.

- J. In the event that an existing coating's max recoat window has been exceeded, all surfaces to be overcoated must be thoroughly and uniformly de-glossed and scarified before the application of additional coatings.
- K. All surfaces must be clean and dry prior to the application of any coatings.

3.04 PRETREATMENTS

When specified, the surface shall be pretreated in accordance with the specified pretreatment prior to application of the prime coat of paint.

3.05 STORAGE

Materials shall be delivered to the job site in the original packages with seals unbroken and with legible unmutilated labels attached. Packages shall be available for inspection by the Owner. All coating materials shall be stored in accordance with the Manufacturer's latest written recommendations. The Contractor is responsible for following the Manufacturer's suggested storage temperatures and conditions. The Contractor shall be solely responsible for the protection of the materials stored by himself at the job site. Empty coating cans shall be neatly stacked in an area designated by the Owner and removed from the job site on a schedule determined by the Contractor. Owner may request a notarized statement from Contractor detailing all materials used on the Project.

3.06 PREPARATION OF MATERIALS

- A. Mechanical mixers, capable of thoroughly mixing the pigment and vehicle together, shall mix the paint prior to use where required by manufacturer's instructions; thorough hand mixing will be allowed for small amounts up to one gallon. Pressure pots shall be equipped with mechanical mixers to keep the pigment in suspension, when required by manufacturer's instructions. Otherwise, intermittent hand mixing shall be done to assure that no separation occurs. All mixing shall be done in accordance with SSPC Vol. 1, Chapter 4, "Practical Aspects, Use and Application of Paints" and/or with manufacturer's recommendations.
- B. Thinners shall be as recommended by the manufacturer and shall be added or discarded strictly in accordance with the manufacturer's instruction. Partial kits may only be used when components are accurately measured and mixed per the Manufacturer's latest written recommendations.

3.07 APPLICATION

- A. Paint shall be applied only on thoroughly dry surfaces and during periods of favorable weather, unless otherwise allowed by the paint manufacturer. Except as provided below, painting shall not be permitted when the atmospheric temperature is outside the limit of the manufacturer's latest written recommendations, or when freshly painted surfaces may be damaged by rain, fog, dust, or condensation, and/or when it can be anticipated that these

conditions will prevail during the drying period.

- B. No coatings shall be applied unless surface temperature is a minimum of 5°F above dew point; temperature must be maintained during curing.
- C. See coating schedule for actual coating systems to be used on this project.

3.08 DEW POINT CALCULATION CHART

DEW POINT CALCULATION CHART

Ambient Air Temperature - Fahrenheit

Relative Humidity

	20	30	40	50	60	70	80	90	100	110	120
90%	18	28	37	47	57	67	77	87	97	107	117
85%	17	26	36	45	55	65	76	84	95	104	113
80%	16	25	34	44	54	63	73	82	93	102	110
75%	15	24	33	42	52	62	71	80	91	100	108
70%	13	22	31	40	50	60	68	78	88	96	105
65%	12	20	29	38	47	57	66	76	85	93	103
60%	11	20	27	36	45	55	64	73	83	92	101
55%	9	17	25	34	43	53	61	70	80	89	98
50%	6	15	23	31	40	50	59	67	77	86	94
45%	4	13	21	29	37	47	56	64	73	82	91
40%	1	11	18	26	35	43	52	61	69	78	87
35%	-2	8	16	23	31	40	48	57	65	74	83

SURFACE TEMPERATURE AT WHICH CONDENSATION OCCURS

Dew Point

Temperature at which moisture will condense on surface. No coatings should be applied unless surface temperature is a minimum of 5°F above this point. Temperature must be maintained during curing.

Example

If air temperature is 70°F and relative humidity is 65%, the dew point is 57°F. No coating should be applied unless surface temperature is 62°F minimum.

- A. No coating shall be applied unless the relative humidity is below 85%.
- B. Suitable enclosures to permit painting during inclement weather may be used if provisions are made to control atmospheric conditions artificially inside the enclosure, within limits suitable for painting throughout the painting operations.

- C. Field painting in the immediate vicinity of, or on, energized electrical and rotating equipment, and equipment and/or pipes in service shall not be performed without the approval of the Owner.
- D. Extreme care shall be exercised in the painting of all operable equipment, such as valves, electric motors, etc., so that the proper functioning of the equipment will not be affected.
- E. The Contractor's scaffolding shall be erected, maintained and dismantled without damage to structures, machinery, equipment or pipe. Drop cloths shall be used where required to protect buildings and equipment. All surfaces required to be clear for visual observation shall be cleaned immediately after paint application.
- F. Painting shall not be performed on insulated pipe within three (3) feet of insulation operations or on insulation whose covering and surface coat have not had time to set and dry. Painting shall not be performed on uninsulated pipe within one (1) foot of any type of connection until the connection has been made, except as directed by the Owner.
- G. The prime coat shall be applied immediately following surface preparation and in no case later than the same working day. All paint shall be applied by brushing, paint mitt and roller, conventional spraying, or airless spraying, using equipment approved by the paint manufacturer.
- H. Each coat of paint shall be recoated as per manufacturer's instructions. Paint shall be considered recoatable when an additional coat can be applied without any detrimental film irregularities such as lifting or loss of adhesion.
- I. Surfaces that will be inaccessible after assembly shall receive either the full specified paint system or three shop coats of the specified primer before assembly.
- J. Unless otherwise specified, each full coat within a coating system shall be of a different or alternating color.
- K. Finish colors shall be in accordance with the COLOR SCHEDULE and shall be factory mixed (i.e., there shall be no tinting by the Contractor, unless authorized by the Owner).
- L. All edges and weld seams in immersion service shall receive a "stripe coat" (applied by brush) of the 2nd coat prior to application of the full 2nd coat.
- M. All open seams in the roof area of tanks shall be filled after application of the topcoat with a flexible caulking such as Sika Flex 1A.

3.09 WORKMANSHIP

- A. The Contractor must submit, with their bid, a list of a minimum 5 completed projects of similar size and complexity to this work with the use of Tnemec

City of Clearwater

**NE WRF MCC-1, DC1 & 2 REPLACEMENT
17-0028-UT
00992-0254**

***Painting
09 90 00-11***

coatings. Include for each project:

1. Project name & location
2. Name & contact of owner
3. Name & contact of engineer
4. Approximate area of coatings applied
5. Total project amount value
6. Date of completion

- B. The Contractor must have a minimum NACE or PCI Level 1 on staff.
- C. The Contractor must show proof that all employees associated with this Project shall have been employed by the Contractor for a period not less than six (6) months.
- D. Painting shall be performed by experienced painters in accordance with the recommendations of the paint manufacturer. All paint shall be uniformly applied without sags, runs, spots, or other blemishes. Work which shows carelessness, lack of skill, or is defective in the opinion of the Owner, shall be corrected at the expense of the Contractor.

3.10 APPLICATION OF PAINT

A. By Brush and/or Rollers

1. Top quality, properly styled brushes and rollers shall be used. Rollers with a baked phenol core shall be utilized.
2. The brushing or rolling shall be done so that a smooth coat as nearly uniform in thickness as possible is obtained. Brush or roller strokes shall be made to smooth the film without leaving deep or detrimental marks.
3. Surfaces not accessible to brushes or rollers may be painted by spray, by dauber or sheepskins, and paint mitt.
4. It may require two coats to achieve the specified dry film thickness if application is by brush and roller.

B. Air, Airless or Hot Spray

1. The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied and shall be equipped with suitable pressure regulators and gauges.
2. Paint shall be applied in a uniform layer, with a 50% overlap pattern. All runs and sags should be brushed out immediately or the paint shall be removed and the surface resprayed.
3. High build coatings should be applied by a cross-hatch method of spray application to ensure proper film thickness of the coating.
4. Areas inaccessible to spray shall be brushed; if also inaccessible to brush, daubs or sheepskins shall be used, as authorized by the manufacturer.
5. Thinners shall be as recommended by the manufacturer and shall be added or discarded strictly in accordance with the manufacturer's

- instruction.
6. Nozzles, tips, etc., shall be of sizes and designs as recommended by the manufacturer of the paint being sprayed.
 7. The first coat on concrete surfaces in immersion service should be sprayed and back rolled.

3.11 PROTECTION AND CLEANUP

- A. It shall be the responsibility of the Contractor to protect at all times, in areas where painting is being done, floors, materials of other crafts, equipment, vehicles, fixtures, and finished surfaces adjacent to paint work. Cover all electric plates, surface hardware, nameplates, gauge glasses, etc., before start of painting work.
- B. At the option of the Owner during the course of this project, the Contractor will contain all spent abrasives, old paint chips, paint overspray and debris by means suitable to the Owner, including, but not limited to, full shrouding of the area.
- C. If shrouding is required, the Contractor must provide a complete design of the intended shroud or cover. Care must be taken not to modify or damage the structure during the use of the shroud. If damage should occur, the Contractor is held responsible for all repairs.
- D. At completion of the work, remove all paint where spilled, splashed, spattered, sprayed or smeared on all surfaces, including glass, light fixtures, hardware, equipment, painted and unpainted surfaces.
- E. After completion of all painting, the Contractor shall remove from job site all painting equipment, surplus materials and debris resulting from this work.
- F. The Contractor is responsible for the removal and proper disposal of all hazardous materials from the job site in accordance with Local, State and Federal requirements as outlined by the Environmental Protection Agency.
- G. A notarized statement shall be presented to the Owner that all hazardous materials have been disposed of properly including, but not limited to: name of disposal company, disposal site, listing of hazardous materials, weights of all materials, cost per pound and EPA registration number.

3.12 TOUCH-UP and TOUCH-UP MATERIALS

- A. All areas which require field touch-up after erection, such as welds, burnbacks, and mechanically damaged areas, shall be prepared per the Manufacturer's latest written recommendations.
- B. Strict adherence to manufacturer's complete touch-up recommendations shall be followed. Any questions relative to compatibility of products shall be brought to the Owner and Manufacturer's attention. Otherwise, Contractor assumes full responsibility.

- C. The Contractor shall provide, at the end of the Project, at least one (1) gallon of each generic topcoat in each color as specified by the Owner for future touch-up. Two gallons may be required for (2) component materials.

3.13 ON-SITE INSPECTION

During the course of this Project, the Owner will reserve the option of incorporating the services of a NACE Level III inspection service. The inspection service will be responsible for assuring the proper execution of this Specification by the successful Contractor.

3.14 STEEL & FERROUS METALS

A. FERROUS METALS - NON-IMMERSION / EXTERIOR / UV-EXPOSED

The coating systems in the FERROUS METALS - NON-IMMERSION / EXTERIOR / UV-EXPOSED section are listed in order of decreasing color & gloss retention and corrosion resistance. The first system has maximum color & gloss retention and maximum corrosion resistance.

1. System No. 700-1: Zinc/Epoxy/Fluoropolymer

This system provides outstanding resistance to ultra-violet light degradation and the absolute best color and gloss retention available. This system will have excellent resistance to abrasion and chalking, and is recommended for coastal environments and on structures where extremely long-term maintenance cycles are desired (such as elevated tanks and surfaces with custom artwork). (Note: Series 700 is gloss. If the Owner desires a semi-gloss finish then Series 700 may be replaced with Series 701.) Note: For single-component application, Series 90G-1K97 may be substituted as the primer.

Surface Preparation: SSPC-SP6/NACE No.3 Commercial Blast Cleaning with a minimum 1.5 mil angular anchor profile.

Primer: Series 90-97 Tneme-Zinc	2.5 - 3.5 mils
2nd Coat: Series 66 Hi-Build Epoxoline	3.0 - 6.0 mils
3rd Coat: Series 700 Hydroflon	<u>2.0 - 3.0 mils</u>

Total Dry Film Thickness: 7.5 - 12.5 mils
 Minimum Dry Film Thickness: 9.5 mils

2. System No. 1095-1: Zinc/Epoxy/Urethane

This system offers excellent color & gloss retention with the added corrosion protection of a zinc rich primer. Series 90-97 Tneme-Zinc is an organic zinc-rich primer that can be used for field touch up of a zinc primer or for touch up of galvanized surfaces that are damaged. For single-component applications, Series 90G-1K97 may be substituted for

Series 90-97. Series 1095 has a semi-gloss finish. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

Surface Preparation: SSPC-SP6/NACE No.3 Commercial Blast Cleaning with a minimum 1.5 mil angular anchor profile.

Shop Coat: Series 90-97 Tneme-Zinc	2.5 - 3.5 mils
2nd Coat: Series 66 Hi-Build Epoxoline	3.0 - 6.0 mils
3rd Coat: Series 1095 Endurashield	<u>2.5 - 5.0 mils</u>
Total Dry Film Thickness: 8.0 - 14.5 mils	
Minimum Dry Film Thickness: 10.0 mils	

3. System No. 1095-2: Epoxy/Epoxy/Urethane

This system is highly resistant to abrasion, wet conditions, corrosive fumes and chemical contact. It provides excellent color & gloss retention. This system should be used for exterior steel surfaces that are neither submerged, nor buried. Series 161 may be substituted for Series 66 for low temperature cure or quick recoats. Series 1095 has a semi-gloss finish. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

Surface Preparation: SSPC-SP6/NACE No.3 Commercial Blast Cleaning with a minimum 1.5 mil angular anchor profile.

Shop Coat: Series 66-1211 Hi-Build Epoxoline Primer	3.0 - 6.0 mils
2nd Coat: Series 66 Hi-Build Epoxoline	3.0 - 6.0 mils
3rd Coat: Series 1095 Endura-Shield	<u>2.0 - 5.0 mils</u>
Total Dry Film Thickness: 8.0 - 17.0 mils	
Minimum Dry Film Thickness: 10.0 mils	

4. System No. 1095-3: Epoxy Mastic/Urethane (Overcoat)

This system can be used over factory finish paint or over non-sandblasted steel and offers the high performance of an epoxy/urethane system. Series 1095 has a semi-gloss finish. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

Surface Preparation: High Pressure Water Clean (min. 3500 psi, 3 to 5 gallons per minute, using an oscillating tip and potable water). A cleaning detergent such as Trisodium Phosphate should be used to facilitate cleaning. A degreaser may be required for oil soaked areas or heavily contaminated areas.

Some spot areas may require Hand Tool (SSPC-SP2), Power Tool Cleaning (SSPC-SP3), or Brush Blast (SSPC-SP7/NACE No. 4) to remove loose surface rust.

Existing coatings must be clean, dry, and tightly adhering prior to application of coatings.

Spot Prime (Areas of Bare Steel): Series 135 Chembuild	4.0 – 6.0 mils
1st Coat: Series 135 Chembuild	4.0 - 6.0 mils
2nd Coat: Series 1095 Endura-Shield	<u>2.0 - 5.0 mils</u>
Total Dry Film Thickness: 6.0 - 11.0 mils*	
Minimum Dry Film Thickness: 7.0 mils	

**Does not include spot prime or previously existing coatings.*

B. EXTERIOR BELOW GRADE EXPOSURE

1. System No. N140-1: Epoxy/Epoxy/Epoxy or Urethane

This system provides exceptional corrosion protection in buried environments. It offers better corrosion protection and a healthier application process than coal-tar epoxies. The 3rd coat is dependent on the exposure – for buried areas use an extra coat of high-solids epoxy, for uv-exposed, non-immersion areas use an aliphatic acrylic urethane. Series 1095 has a semi-gloss finish. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

Surface Preparation: SSPC-SP10/NACE No. 2 Near-White Blast Cleaning with a minimum angular anchor profile of 1.5 mils.

Shop Coat: Series N140 Pota-Pox Plus	2.0 – 10.0 mils
2nd Coat: Series N140 Pota-Pox Plus	4.0 - 10.0 mils
3rd Coat (Buried Areas Only): Series N140 Pota-Pox Plus	4.0 - 10.0 mils
3rd Coat (UV Exposed, Non-immersion Areas Only): Series 1095	<u>2.5 - 5.0 mils</u>
Total Dry Film Thickness: 10.0 – 30.0 mils	
Minimum Dry Film Thickness: 11.0 mils	

2. System No. 46H-413-1: Polyamide Epoxy-Coal Tar

This system provides a high-build coating for underground conditions.

Surface Preparation: SSPC-SP10/NACE No. 2 Near-White Blast Cleaning with a minimum angular anchor profile of 1.5 mils.

1st Coat: Series 46H-413 Hi-Build Theme-Tar	8.0 - 10.0 mils
2nd Coat: Series 46H-413 Hi-Build Theme-Tar	<u>8.0 - 10.0 mils</u>
Total Dry Film Thickness: 16.0 - 20.0 mils	
Minimum Dry Film Thickness: 18.0 mils	

C. INTERIOR (NON-IMMERSION)

1. System No.66-1: Polyamide Epoxy

This system will provide chemical and corrosion resistance against abrasion, moisture, corrosion fumes, and occasional chemical contact. Primer coat must be touched-up before second coat is applied. Substitute Series 161 for low temperature cure or quick recoats. Use this system for interior exposed, non-submerged metals.

Surface Preparation: SSPC-SP6/NACE No.3 Commercial Blast Cleaning with a minimum 1.5 mil angular anchor profile.

Shop Coat: Series 66 Hi-Build Epoxoline	3.0 - 5.0 mils
2nd Coat: Series 66 Hi-Build Epoxoline	4.0 - 6.0 mils
3rd Coat: Series 66 Hi-Build Epoxoline	<u>4.0 - 6.0 mils</u>
Total Dry Film Thickness: 7.0 - 11.0 mils	
Minimum Dry Film Thickness: 9.0 mils	

2. System No. 27WB-1: Inorganic Hybrid Water-Based Epoxy (Overcoat)

This low VOC system can be used over factory finish paint or over non-sandblasted steel and offers the high performance of an epoxy/urethane system. Series 1095 has a semi-gloss finish. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

Surface Preparation: Abrasive blast cleaning in accordance with SSPC-SP7/NACE No.4 generally produces the best coating performance. If conditions will not permit this, Series 27WB may be applied to SSPC-SP2 or SP3 Hand or Power Tool Cleaned surfaces (SSPC Rust Grade Condition C).

Shop Coat: Manufacturer's Standard (or existing coating)	varies
Spot Prime (Areas of Bare Steel): Series 27WB Typoxy	3.0 - 8.0 mils
2nd Coat: Series 27WB Typoxy	3.0 - 8.0 mils
3rd Coat: Series 1095 Endura-Shield	<u>2.5 - 5.0 mils</u>
Total Dry Film Thickness: 5.5 - 13.0 mils*	
Minimum Dry Film Thickness: 7.0 mils	

**Does not include spot prime or previously existing coatings.*

D. IMMERSION

1. System No. 104-1: Cycloaliphatic Amine Epoxy (Non-Potable Water)

This system will provide chemical and corrosion resistance for protection against moisture, corrosive fumes, chemical contact and immersion in **mild to moderate** wastewater, such as clarifiers, chlorine contact basins, aeration basins, settling basins and other open top (aerobic) structures. Shop coat must be touched-up before second coat is applied.

Surface Preparation: SSPC-SP10/NACE No.2 Near-White Blast Cleaning

with a minimum 1.5 mil angular anchor profile.

Shop Coat: Series 1 Omnithane	2.5 - 3.5 mils
2nd Coat: Series 104 Hi-Build Epoxoline	6.0 - 8.0 mils
3rd Coat: Series 104 Hi-Build Epoxoline	<u>6.0 - 8.0 mils</u>
Total Dry Film Thickness: 14.5 - 19.5 mils	
Minimum Dry Film Thickness: 15.5 mils	

Allow Series 104 to cure for 7 days at 75°F prior to immersion service.

2. System No. 142-1: Flake / Aluminum Oxide Filled Polyamine Epoxy (Non-Potable Water)

This system will provide chemical and corrosion resistance for protection against moisture, corrosive fumes, chemical contact and immersion in **mild to moderate wastewater where increased abrasion resistance is required.**

Surface Preparation: SSPC-SP-10/NACE No.2 Near-White Metal Blast Cleaning (1.5 Mil Profile)

1st Coat: Series 1 Omnithane	2.5 -
3.5 mils	
2nd Coat: Series 142 Epoxoline	<u>14 - 18.0 mils</u>
Total Dry Film Thickness: 16.5 – 23.5 mils	
Minimum Dry Film Thickness: 20.0 mils	

3. System No. 446-1: Hydrophobic Aromatic Polyurethane (Non-Potable)

This system will provide exceptional chemical and corrosion resistance for protection against moisture, corrosive fumes, chemical contact and **immersion in mild to moderate wastewater environments. This system is designed for situations where an extremely quick return to service is required.**

Surface Preparation: SSPC-SP10/NACE No.2 Near-White Blast Cleaning.

1st Coat: Series 1 Omnithane	2.5 –
3.5 mils	
2nd Coat: 446 Perma-Shield MCU	6.0 - 8.0 mils*
3rd Coat: 446 Perma-Shield MCU	<u>6.0 - 8.0 mils*</u>
Total Dry Film Thickness: 14.5 - 19.5 mils	
Minimum Dry Film Thickness: 16.0 mils	

**Exceeding 10.0 mils per coat of Series 446 may cause blistering.*

Notes:

1. Series 446 is not color stable. Its color may change drastically,

which will not affect the performance of the product.

2. Allow Series 446 to cure for 4 hours at 75°F prior to service.

4. System No. 142-2: Flake / Aluminum Oxide Filled Polyamine Epoxy (Methanol Liner)

This system will provide chemical and corrosion resistant liner suitable for methanol immersion service.

Surface Preparation: SSPC-SP-10/NACE No.2 Near-White Metal Blast Cleaning (1.5 Mil Profile)

2nd Coat: Series 142 Epoxoline 15.0 - 18.0 mils
Total Dry Film Thickness: 15.0 – 18.0 mils
Minimum Dry Film Thickness: 15.0 mils

5. System No. 365-1: Novolac Epoxy (Sulfuric Acid Liner)

This system is a spray applied, 100% solids, high build, reinforced epoxy formulated for general use as an internal lining for tanks and other aggressive chemical immersion service. This lining is suitable for immersion service in 98% sulfuric acid, and **requires the use of heated plural component equipment to apply.**

Surface Preparation: SSPC-SP5/NACE No. 1 White Metal Blast Cleaning with a minimum angular anchor profile of 3.0 mils. Refer to the Series 365 Application Guide.

Surfacer/Filler (As needed to fill pits and voids): Series 351 Tank Armor

*Stripe Coat: Brush Series 365 Tank Armor into welds, seams, and edges

*Full Coat: Series 365 Tank Armor 35.0 – 50.0 mils
Total Dry Film Thickness: 35.0 – 50.0 mils

*Consult the manufacturer's latest written recommendations and application guide before applying.

Notes:

1. If the humidity is anticipated to exceed 80%, dehumidification equipment is required.
2. Allow Series 365 to cure for 48 hours at 75°F prior to service.

6. System No. 22-1: Modified Polyamine Epoxy (Potable Water)

This is a low VOC system which meets the requirements of approval for potable water use as established by NSF Std 61. **This system may be applied up to 40.0 mils in a single coat, providing exceptional barrier**

protection and a quicker return to service. This system is intended for use over simple shapes and areas with minimal detail work.

Surface Preparation: SSPC-SP10/NACE No.2 Near-White Blast Cleaning with a minimum angular anchor profile of 3.0 mils.

Pre-patch (sharp, angular pits and voids): Series 215 as needed
Stripe Coat: Series 22 Weld Seams and Edges
Topcoat: Series 22 22.0 - 27.0 mils*
Total Dry Film Thickness: 22.0 - 27.0 mils

**In order to maintain NSF Std. 61 approval, maximum allowable DFT is 50.0 mils.*

Notes:

1. Series 22 is to be spray applied only.
2. Allow Series 22 to cure for a minimum of 5 days at 75°F prior to service.

7. System No. 20-1: Polyamide Epoxy (Potable Water)

This system meets American Water Works Association AWWA D 102 Inside Paint System Number 1. Series 20 meets the requirements of approval for potable water use as established by NSF Std 61. Series FC20 may be substituted for Series 20 for low temperature cure or quick recoats.

Surface Preparation: SSPC-SP10/NACE No.2 Near-White Blast Cleaning with a minimum angular anchor profile of 2.0 mils.

Shop Coat: Series 94H₂O Hydro-Zinc 2.5 – 3.5 mils
Stripe Coat (Weld Seams and Edges): 20 Pota-Pox 3.0 - 5.0 mils
2nd Coat: Series 20-1255 Pota-Pox (Beige) 4.0 - 6.0 mils
3rd Coat: Series 20-15BL Pota-Pox (Tank White) 4.0 - 6.0 mils
Total Dry Film Thickness*: 10.5 - 15.5 mils**
Minimum Dry Film Thickness: 11.5 mils

**Total Dry Film Thickness excludes stripe coat*

***Note: In order to maintain NSF Std. 61 approval, maximum allowable DFT is 18 mils.*

Allow Series 20 to cure for 7 days at 75°F prior to service.

3.15 OVERHEAD METAL DECKING, JOISTS

A. EXTERIOR EXPOSURE

System No. 1029-1: HDP Acrylic Polymer

This system can be applied over a wide variety of coatings and factory finishes. It can also be applied direct to galvanized decking, joists, & conduits. Series 1029 is suitable for application in mild to moderate exposures.

Surface Preparation: Pressure clean to remove all dirt, oil, grease, chemicals and foreign contaminants. Remove loose paint and all rust by hand and power tool cleaning (SSPC-SP 2 & 3)

1st Coat: Series 115 Uni-Bond	2.5 - 4.0 mils
2nd Coat: Series 1029 Enduratone	2.0 - 3.0 mils
Total Dry Film Thickness: 4.5 - 7.0 mils	

B. INTERIOR EXPOSURE

System No. 115-1: Self-crosslinking Hydrophobic Acrylic

This system should be used on ceilings of non-chemical storage areas where a one-coat system is desired. Can be applied over steel, galvanized and aluminum decking, joist, shop primed beams, conduits and concrete. Note: Series 115 has "dry-fall" characteristics. See manufacturer's latest written Product Data Sheet for details.

Surface Preparation: Surfaces must be dry, clean and free of oil, grease and other contaminants.

One Coat: Series 115 Uni-Bond	<u>2.5 - 4.0 mils</u>
Total Dry Film Thickness: 2.5 - 4.0 mils	

3.16 GALVANIZED STEEL & NONFERROUS METALS

A. GALVANIZED STEEL, STAINLESS STEEL, ALUMINUM, OR COPPER

System No. 1095-4: Epoxy/High Build Urethane

Series 66 has excellent adhesion to galvanized steel & nonferrous metals. This system is highly resistant to abrasion, wet conditions, corrosive fumes and chemical contact. It provides excellent color & gloss retention. Series 1095 has a semi-gloss finish. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

Surface Preparation: SSPC-SP1 Solvent Cleaning, followed by mechanically abrading (SSPC-SP7/NACE No.4, minimum angular anchor profile of 1.5 mils)

1st Coat: Series 66 Hi-Build Epoxoline	2.0 - 4.0 mils
2nd Coat: Series 1095 Endura-Shield	<u>2.5 - 5.0 mils</u>
Total Dry Film Thickness: 4.5 - 9.0 mils	
Minimum Dry Film Thickness: 5.0 mils	

B. ALUMINUM IN CONTACT WITH CONCRETE

System No. 46H-413-2: Polyamide Epoxy

Surface Preparation: SSPC-SP1 Solvent Cleaning, followed by thoroughly scarifying to de-gloss and provide a minimum uniform angular anchor profile of 1.0 mil.

1st Coat: Series 46H-413 Hi-Build Tneme-Tar	8.0 - 10.0 mils
2nd Coat: Series 46H-413 Hi-Build Tneme-Tar	<u>8.0 - 10.0 mils</u>
Total Dry Film Thickness: 16.0 - 20.0 mils	
Minimum Dry Film Thickness: 18.0 mils	

3.17 CONCRETE & MASONRY

A. EXTERIOR - ABOVE GRADE (NON-IMMERSION, VERTICAL SURFACES)

1. System No. 156-1: Modified Waterborne Acrylate (Elastomeric)

This system provides exceptional elongation for spanning hairline cracks in concrete structures. It also provides mold & mildew resistance, as well as wind-driven rain resistance. For application over previously applied coatings, use TNE MEC Series 151 Elasto-Grip at 0.7 - 1.5 mils DFT prior to the application of Series 156 Enviro-Crete. Note: If a textured finish is preferred, use 157 Enviro-Crete TX (medium texture) @ 6.0 – 9.0 mils dry film thickness per coat.

Surface Preparation: Allow concrete to cure for 28 days. Surface must be clean and dry.

1st Coat: Series 156 Enviro-Crete	4.0 - 8.0 mils
2nd Coat: Series 156 Enviro-Crete	<u>4.0 - 8.0 mils</u>
Total Dry Film Thickness: 8.0 - 16.0 mils	
Minimum Dry Film Thickness: 10.0 mils	

2. System No. 1026-1: Acrylic Emulsion (Non-Elastomeric)

This system provides a durable, easy-to-use, water-based coating that offers long-wearing protection. It is low odor, low VOC, and has “dry-fall” properties. See manufacturer’s latest written Product Data Sheet for details. This system will provide a high vapor transmission rate.

Surface Preparation: Allow concrete to cure for 28 days. Surface shall be clean and dry.

Block Filler (CMU only): 1254 Epoxoblock	100 – 150 ft ² /Gallon
1st Coat: Series 1026 Enduratone	2.0 - 3.0 mils
2nd Coat: Series 1026 Enduratone	<u>2.0 - 3.0 mils</u>
Total Dry Film Thickness: 4.0 - 6.0 mils*	

Minimum Dry Film Thickness: 5.0 mils

*Does not include Block Filler

3. System No. 662-1: Silane /Siloxane Sealer (Min. 42% Solids)

This provides a clear, filmless, penetrating water repellent for virtually all above-grade, vertical and horizontal concrete, stucco, block, and brick masonry. This will allow the substrate to resist water and chloride ion intrusion, stain damage, freeze/thaw spalling, efflorescence, and rust damage. This system will not alter the color or texture of the surface, nor significantly affect the vapor transmission qualities of the substrate. This barrier is also resistant to ultraviolet and weather deterioration.

Surface Preparation: Allow new concrete to cure 28 days. All surfaces must be clean, dry, and free of oils, curing compounds, form release oils, and other contaminants that might interfere with the penetration of the sealer.

For Coating Brick & Concrete:

Tnemec Series 662.....Two Coats @ 75-200 ft²/gallon

For Coating Split-faced or Porous Masonry:

Tnemec Series 662.....Two Coats @ 35-100 ft²/gallon

4. System No. 626-1: Water Repellent and Graffiti Protectant

This provides superior protection against, and easy removal of, unwanted graffiti. **Series 626 is intended for use in conjunction with Series 680 Mark A Way (Cleaner) to provide a complete graffiti protection system.** This is a clear, silicone rubber-based formulation which protects vertical concrete block, brick, cast concrete, stone, and other masonry substrates with little or no change to the appearance of the untreated substrate. It has excellent stability against ultraviolet rays and salt spray.

Surface Preparation: Allow new concrete to cure 28 days. All surfaces must be clean, dry, and free of oils, curing compounds, form release oils, and other contaminants that might interfere with the penetration of the sealer.

For Coating Brick & Concrete:

Tnemec Series 626.....Two Coats @ 125-200 ft²/gallon

For Coating Split-faced or Porous Masonry:

Tnemec Series 626.....Two Coats @ 65-150 ft²/gallon

B. EXTERIOR - BELOW GRADE

1. System No. 46H-413-3: Polyamide Epoxy-Coal Tar

This system provides a high-build coating for underground conditions.

Surface Preparation: Allow new concrete to cure for 28 days. Surface shall be clean and dry.

One or Two Coats: 46H-413 Hi-Build Tneme-Tar

Total Dry Film Thickness: 16.0 - 20.0 mils*

C. INTERIOR (NON-IMMERSION)

The coating systems in the INTERIOR (NON-IMMERSION) section are listed in order of decreasing performance with regards to chemical & corrosion resistance. This generally has an inverse correlation with color & gloss retention. The first system has extremely good chemical resistance with the highest potential for yellowing, while the last system has extremely poor chemical resistance with the lowest potential for yellowing.

1. System No. 104-2: Cycloaliphatic Amine Epoxy

This system will produce a tile-like finish for easy cleaning and superior stain resistance. It will also provide protection against chemical attack, corrosive fumes, high humidity and wash down. Backroll first coat to fill porosity.

Surface Preparation: Allow new concrete and masonry to cure for 28 days. Surface must be clean and dry.

For New Concrete or Porous Masonry: Apply Tnemec Series 1254 Epoxoblock WB @ 100 – 150 ft²/Gallon.

1st Coat: Series 104 H.S. Epoxy (backrolled)	8.0 - 10.0 mils
2nd Coat: Series 104 H.S. Epoxy	<u>8.0 - 10.0 mils</u>
Total Dry Film Thickness: 16.0 - 20.0 mils	
Minimum Dry Film Thickness: 18.0 mils	

2. System No. 66-2: Polyamide Epoxy

This system provides excellent protection from abrasion, moisture, corrosive fumes and chemical contact.

Surface Preparation: Allow new concrete and masonry to cure for 28 days. Surface must be clean and dry.

For New Concrete or Porous Masonry: Apply Tnemec Series 1254 Epoxoblock WB @ 100 – 150 ft²/Gallon.

1st Coat: Series 66 Hi-Build Epoxoline	4.0 - 6.0 mils
2nd Coat: Series 66 Hi-Build Epoxoline	<u>4.0 - 6.0 mils</u>

Total Dry Film Thickness: 8.0 -12.0 mils
Minimum Dry Film Thickness: 10.0 mils

3. System No. 113-1: Acrylic-Epoxy

This system will provide high performance and can be applied directly over existing coatings without lifting. Can be used when low odor is required during application. Note: Series 113 has a Satin finish. For a gloss finish, specify Series 114 Tneme-Tufcoat.

Surface Preparation: Allow new concrete and masonry to cure for 28 days. Surface must be clean and dry.

For New Concrete or Porous Masonry: Apply Tnemec Series 1254 Epoxoblock WB @ 100 – 150 ft²/Gallon.

1st Coat:113 Tneme-Tufcoat 4.0 – 6.0 mils
2nd Coat:113 Tneme-Tufcoat 4.0 – 6.0 mils

Total Dry Film Thickness: 8.0 - 12.0 mils
Minimum Dry Film Thickness: 9.0 mils

4. System No. 1026-2: Acrylic Emulsion

This system provides a durable, easy-to-use, water-based coating that offers long-wearing protection. It is low odor, low VOC, and has “dry-fall” properties. See manufacturer’s latest written Product Data Sheet for details. This system will provide a high vapor transmission rate. Note: Series 1026 has a Matte finish. For a Semi-Gloss finish, specify Series 1029 Enduratone.

Surface Preparation: Surface shall be clean and dry. Allow concrete to cure for 28 days.

Block Filler (CMU only): 54 Masonry Filler 80 – 100 ft²/Gallon
1st Coat: Series 1026 Enduratone 2.0 - 3.0 mils
2nd Coat: Series 1026 Enduratone 2.0 - 3.0 mils

Total Dry Film Thickness: 4.0 - 6.0 mils*
Minimum Dry Film Thickness: 5.0 mils

**Does not include Block Filler*

D. IMMERSION

1. System No. 104-3: Cycloaliphatic Amine Epoxy (Non-Potable Water)

This system will provide chemical and corrosion resistance for protection against abrasion, moisture, corrosive fumes, chemical contact and immersion in **mild to moderate** Wastewater, such as clarifiers, chlorine contact basins, aeration basins, settling basins and other open top

(aerobic) structures.

Surface Preparation: Allow new concrete to cure for 28 days. Mechanically abrade per SSPC-SP13/NACE No.6 to remove all laitance, fines, curing compounds, form release oils, and other contaminants, and to establish a surface profile equal to ICRI CSP 5 or greater.

Apply Tnemec Series 218 to all surfaces at a minimum of 1/16" to re-surface concrete, fill voids and bugholes, mitigate concrete outgassing, and to create a monolithic, paintable surface.

1st Coat: 104-1255 H.S. Epoxy Primer (backrolled)	6.0 - 8.0 mils
2nd Coat: 104 H.S. Epoxy	6.0 - 8.0 mils
3rd Coat: 104 H.S. Epoxy	<u>6.0 - 8.0 mils</u>
Total Dry Film Thickness: 18.0 - 24.0 mils	
Minimum Dry Film Thickness: 20.0 mils	

Allow Series 104 to cure for 7 days at 75°F prior to immersion service.

2. System No. 142-3: Flake/Aluminum Oxide Filled Polyamine Epoxy (Non-Potable Water)

This system will provide chemical and corrosion resistance for protection against moisture, corrosive fumes, chemical contact and immersion in **mild to moderate wastewater where increased abrasion resistance is required.**

Surface Preparation: Allow new concrete to cure for 28 days. Mechanically abrade per SSPC-SP13/NACE No.6 to remove all laitance, fines, curing compounds, form release oils, and other contaminants, and to establish a surface profile equal to ICRI CSP 5 or greater.

Apply Tnemec Series 218 to all surfaces at a minimum of 1/16" to re-surface concrete, fill voids and bugholes, mitigate concrete outgassing, and to create a monolithic, paintable surface.

1st Coat: Series 142 Epoxoline	8.0 - 10.0 mils
2nd Coat: Series 142 Epoxoline	<u>8.0 - 10.0 mils</u>
Total Dry Film Thickness: 16.0 – 20.0 mils	
Minimum Dry Film Thickness: 18.0 mils	

3. System No. 22-2: Modified Polyamine Epoxy (Potable Water)

This is a low VOC system which meets the requirements of approval for potable water use as established by NSF Std 61. **This system may be applied up to 40.0 mils in a single coat, providing exceptional barrier protection and a quicker return to service.** This system is intended for use over simple shapes and areas with minimal detail work.

Surface Preparation: Allow new concrete to cure for 28 days. Mechanically abrade per SSPC-SP13/NACE No.6 to remove all laitance, fines, curing compounds, form release oils, and other contaminants, and to establish a surface profile equal to ICRI CSP 5 or greater.

Apply Tnemec Series 218 to all surfaces at a minimum of 1/16" to re-surface concrete, fill voids and bugholes, and to create a monolithic, paintable surface.

Single Coat: Series 22 22.0 - 27.0 mils*
Total Dry Film Thickness: 22.0 - 27.0 mils

**In order to maintain NSF Std. 61 approval, maximum allowable DFT is 50.0 mils.*

Notes:

1. Series 22 is to be spray applied only.
2. Allow Series 22 to cure for a minimum of 5 days at 75°F prior to service.

4. System No. 20-2: Polyamide Epoxy (Potable Water)

This system meets American Water Works Association AWWA D 102 Inside System No. 1. Series 20 meets the requirements of approval for potable water use as established by NSF Std 61. Series FC20 may be substituted for Series 20 for low temperature cure or quick recoats.

Surface Preparation: Allow new concrete to cure for 28 days. Mechanically abrade per SSPC-SP13/NACE No.6 to remove all laitance, fines, curing compounds, form release oils, and other contaminants, and to establish a surface profile equal to ICRI CSP 5 or greater.

Apply Tnemec Series 218 to all surfaces at a minimum of 1/16" to re-surface concrete, fill voids and bugholes, and to create a monolithic, paintable surface.

1st Coat: Series 20-15BL Pota-Pox 4.0 - 6.0 mils
2nd Coat: Series 20-1255 Pota-Pox 4.0 - 6.0 mils
3rd Coat: Series 20-15BL Pota-Pox 4.0 - 6.0 mils
Total Dry Film Thickness: 12.0 - 17.0 mils*
Minimum Dry Film Thickness: 13.0 mils

**In order to maintain NSF Std. 61 approval, maximum allowable DFT is 18 mils.*

Allow Series 20 to cure for 7 days at 75°F prior to service.

5. System No. 262-1: Modified Polyurethane (Non-Potable Water)

This system is a flexible liner which provides a seamless monolithic membrane for repairing minor leaking in water basins and reservoirs. This system may also be used to span hairline cracks on substrates where movement may occur.

Surface Preparation: Prepare concrete surfaces in accordance with SSPC-SP13/NACE No.6 Joint Surface Preparation Standards and ICRI Technical Guidelines. Mechanically abrade in accordance with SSPC-SP13/NACE No.6 to remove all existing coatings, laitance, fines, curing compounds, form release oils, and other contaminants, and to establish a surface profile equal to ICRI-CSP 5 or greater.

Apply Tnemec Series 218 Mortarclad Modified Cementitious Mortar to fill all voids and bugholes, and to resurface the entire concrete substrate to a minimum of 1/16".

1st Coat: Series 66 Hi-Build Epoxoline	4.0 - 6.0 mils
2nd Coat: Series 66 Hi-Build Epoxoline	4.0 - 6.0 mils
3rd Coat: Series 262 Elasto-Shield*	<u>65.0 - 75.0 mils</u>
Total Dry Film Thickness: 73.0 - 87.0 mils	
Minimum Dry Film Thickness: 77.0 mils	

** Consult the manufacturer's latest written recommendations and application guide before applying.*

Notes:

1. In order to mitigate outgassing, Series 262 should be applied during periods of declining temperatures.
2. Series 262 Elasto-Shield must be allowed to cure for 2 days before returning to immersion service.

6. System No. 264-1: Modified Polyurethane (Potable Water)

This system is a flexible liner which provides a seamless monolithic membrane **for fixing minor leaking in potable water basins** and reservoirs. This system meets the requirements of approval for potable water use as established by NSF Std 61.

Surface Preparation: Prepare concrete surfaces in accordance with SSPC-SP13/NACE No.6 Joint Surface Preparation Standards and ICRI Technical Guidelines. Mechanically abrade per SSPC-SP13/NACE No.6 to remove all existing coatings, laitance, fines, curing compounds, form release oils, and other contaminants, and to establish a surface profile equal to ICRI-CSP 5 or greater.

Apply Tnemec Series 218 Mortarclad Modified Cementitious Mortar to fill all voids and bugholes, and to resurface the entire concrete substrate to a minimum of 1/16".

1st Coat: Series 20 Pota-Pox	4.0 - 6.0 mils
2nd Coat: Series 20 Pota-Pox	4.0 - 6.0 mils
3rd Coat: Series 264 Elasto-Shield*	<u>60.0 - 70.0 mils</u>
Total Dry Film Thickness: 68.0 - 82.0 mils	
Minimum Dry Film Thickness: 72.0 mils	

**Consult the manufacturer's latest written recommendations and application guide before applying.*

Notes:

1. In order to mitigate outgassing, Series 264 should be applied during periods of declining temperatures.
2. Allow Series 264 to cure for 14 days at 75°F prior to service in a potable water tank (*For non-potable service, allow to cure for 48 hours at 75°F*).

3.18 CONCRETE FLOORS (RESINOUS FLOORING SYSTEMS)

A. EPOXY FLOOR COATINGS

1. System No. 248-1: Aliphatic Moisture Cured Urethane (Thin Film with Increased Chemical Resistance, UV Stability, and Durability)

This system will provide a durable, long-wearing coating that bonds tightly to concrete and stands up under heavy foot traffic, frequent cleaning, spillage of water, oil, grease, or chemical, and UV Exposure. It is recommended that the 2nd and 3rd coat are the same color.

Moisture vapor transmission should not exceed three lbs per 1,000 ft² in a 24 hour period. (Reference ASTM F 1869 "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.") Relative humidity should not exceed 80%. (Reference ASTM F 2170 "Standard Test Method for Determining Relative Humidity in Concrete using in situ Probes.")

Note: For moisture content up to 15 lbs per 1,000 ft² or relative humidity up to 90%, Series 208 should be substituted for Series 201 as the primer. See manufacturer's latest written recommendations for Series 208 coverage rates.

Surface Preparation: Allow new concrete to cure for 28 days.

Mechanically abrade in accordance with NACE No.6/SSPC-SP13 to provide a minimum ICRI-CSP3 or greater surface profile.

1st Coat: Series 201 Epoxoprime	6.0-12.0 mils
2nd Coat: Series 237 Tneme-Glaze	8.0-16.0 mils
3rd Coat: Series 248 Everthane*, tinted with S821 colorant <u>2.0-3.0 mils*</u>	
Total Dry Film Thickness: 16.0- 31.0 mils	

Minimum Dry Film Thickness: 18.0 mils

**Owner's Options for the 3rd Coat:*

- *For exterior exposures and increased resistance to ultra-violet light, add Series 44-600 UV Blocker to Series 248.*
- *If a more textured finish is desired, mix Tnemec Series S211-0213 (Fine) Glass Beads into the 3rd Coat. The glass beads are typically added at approximately 4 – 6 oz. per gallon.*

2. System No. 222-1: Decorative Quartz Flooring (Non-Slip)

This system provides a decorative, chemical, abrasion, impact resistant, non-slip, seamless flooring system with a moisture mitigating base coat that **resists up to 20 lbs of moisture vapor pressure, 99% relative humidity, and can be applied on 10-day old concrete.** This floor utilizes clear resins, allowing for visibility of the quartz or other aggregate. For a solid-color floor, tint the 2nd and 3rd coats with Series 820 field tint.

Surface Preparation: Allow new concrete to cure for 10 days. Mechanically abrade in accordance with NACE No.6/SSPC-SP13 to provide a minimum surface profile equal to ICRI-CSP4-5.

1st Coat: 241 Ultra-Tread MVT (Broadcast with Quartz or aggregate of choice)	70 ft ² per small kit
2nd Coat: 222 Deco-Tread (Broadcast with Quartz or aggregate of choice)	1/16"
3rd Coat: 284 Tneme-Glaze (clear)	<u>8.0 - 12.0 mils*</u>

Minimum Dry Film Thickness: 1/8"

**The degree of slip-resistance is affected by the thickness of the 3rd coat.*

3. System No. 287-1: Waterborne Epoxy-Amine Adduct (Thin-film)

This thin-film system provides a low odor, rapid cure, wear-resistant coating for floors, walls, and other substrates. It is capable of withstanding mild to moderate chemical and solvent exposures and repeated cleanings. **This system may also be used as an overcoat system over well-adhered, unidentified existing coatings.**

Surface Preparation: Allow new concrete to cure for 28 days. Mechanically abrade concrete surfaces in accordance with NACE No.6/SSPC-SP13 to provide an ICRI-CSP 1-3 surface profile.

1st Coat: Series 287 Enviro-Pox	2.0-4.0 mils
2nd Coat: Series 287 Enviro-Pox	<u>2.0-4.0 mils</u>

Total Dry Film Thickness: 4.0-8.0 mils
Minimum Dry Film Thickness: 5.0 mils

3.19 GYPSUM WALLBOARD & WOOD

A. GYPSUM WALLBOARD

The coating systems in the GYPSUM WALLBOARD Section are listed in order of decreasing performance with regards to chemical resistance. This generally has an inverse correlation with color & gloss retention. The first system has very good chemical resistance with the highest potential for yellowing, while the last system has extremely poor chemical resistance with the lowest potential for yellowing.

1. System No. N69-1: Polyamidoamine Epoxy (Interior Only)

This system provides a high-solids, low VOC epoxy coating which offers exceptional protection. It offers superior cleanup and stain-, abrasion-, chemical-, and moisture-resistance.

Surface Preparation: Surface must be clean and dry.

1st Coat: Series 151 Elasto-Grip FC	0.7 - 1.5 mils
2nd Coat: Series N69 Hi-Build Epoxoline II	<u>4.0 - 6.0 mils</u>
Total Dry Film Thickness: 4.7 – 7.5 mils	
Minimum Dry Film Thickness: 5.0 mils	

**If brushing or rolling, two coats may be required to achieve the specified film thickness.*

2. System No. 113-2: Acrylic-Epoxy (Interior Only)

This system is designed for mild environments where frequent cleaning is expected. It provides a higher build, low odor, and fade resistant colors. It offers easy cleanup and stain-, abrasion-, chemical-, and moisture-resistance. Note: Series 113 has a satin finish. If a gloss finish is desired, specify Series 114 Tneme-Tufcoat instead.

Surface Preparation: Surface must be clean and dry.

1st Coat: 51PVA Sealer	1.0 - 2.0 mils
2nd Coat: 113 H.B. Tneme-Tufcoat*	<u>4.0 - 6.0 mils</u>
Total Dry Film Thickness: 5.0 - 8.0 mils	
Minimum Dry Film Thickness: 6.0 mils	

**If brushing or rolling, two coats may be required to achieve the specified film thickness.*

3. System No. 1026--3: Acrylic Emulsion (Interior/Exterior Exposure)

This system is designed for mild use areas like office walls, laboratory ceilings, stairwells, etc. Note: Series 1026 has a Matte finish. For a Semi-

Gloss finish, specify Series 1029 Enduratone.

Surface Preparation: Surface must be clean and dry.

1st Coat: Series 51PVA Sealer	1.0 - 2.0 mils
1st Coat: Series 1026 Enduratone	2.0 - 3.0 mils
2nd Coat: Series 1026 Enduratone	<u>2.0 - 3.0 mils</u>

Total Dry Film Thickness: 4.0 - 6.0 mils
Minimum Dry Film Thickness: 5.0 mils

B. WOOD – EXTERIOR or INTERIOR EXPOSURE

1. System No. 1029-2: HDP Acrylic Polymer

Series 1029 has a low semi-gloss finish. If a gloss finish is desired, specify Series 1028 Enduratone.

Surface Preparation: Surface shall be clean and dry.

1st Coat: 10-99W Undercoater*	2.0 - 3.0 mils
2nd Coat: 1029 Enduratone	2.0 - 3.0 mils
3rd Coat: 1029 Enduratone	<u>2.0 - 3.0 mils</u>

Total Dry Film Thickness: 6.0 - 9.0 mils
Minimum Dry Film Thickness: 7.0 mils

**Allow Series 10 to cure for 3 days before topcoating with Series 1029.*

3.20 HIGH TEMPERATURE COATINGS

A. System No. 1552-1: Acrylic Silicone Copolymer (500°F Maximum)

This system provides heat and corrosion resistance for steel in service environments up to 500°F (315°C). This system has excellent resistance to weathering and UV-light degradation.

Surface Preparation: SSPC-SP6/NACE No.3 Commercial Blast Cleaning with a minimum angular profile of 1.5 mils and a maximum angular anchor profile of 2.0 mils.

1st Coat: Series 1501 Endura-Heat Primer	2.0 - 3.0 mils
2nd Coat: Series 1552 Endura-Heat	<u>2.0 - 3.0 mils</u>

Total Dry Film Thickness: 4.0 - 6.0 mils
Minimum Dry Film Thickness: 4.5 mils

B. System No. 1556-1: Modified Silicone Copolymer (1000°F Maximum)

This system provides galvanic protection for steel in service environments up to 1000°F (538°C). The topcoat outperforms conventional high-temperature topcoats with exceptional color stability, resistance to thermal cycling, and cure

requirements.

Surface Preparation: SSPC-SP6/NACE No.3 Commercial Blast Cleaning with a minimum angular profile of 1.0 mil and a maximum angular anchor profile of 2.0 mils.

1st Coat: Series 1505 Endura-Heat ZR	2.0 - 3.0 mils
2nd Coat: Series 1556 Endura-Heat	<u>2.0 - 3.0 mils</u>
Total Dry Film Thickness: 4.0 - 6.0 mils	
Minimum Dry Film Thickness: 4.5 mils	

Note: Contractor must follow the manufacturer's most recent written recommendations regarding curing procedures.

C. System No. 1528-1: Inert Multipolymeric Matrix (1200°F Maximum)

This system provides high-performance coating protection to steel and stainless steel substrates in elevated temperatures up to 1200°F (648°C). Excellent adhesion properties allow this system to withstand severe thermal cycling (-300°F to 1200°F), and its tolerance to marginally prepared substrates makes it a viable alternative when abrasive blasting is not permitted. Its dry-fall spray characteristic provides a fast, labor-saving coating application when used with the appropriate thinner.

Surface Preparation for Exterior Exposure: SSPC-SP6/NACE 3 Commercial Blast Cleaning or ISO Sa 2 Thorough Blast Cleaning with a minimum angular anchor profile of 1.5 mils and a maximum angular anchor profile of 3.0 mils. Note: Abrasive blast cleaning generally produces the best coating performance. If conditions will not permit this, Series 1528 may be applied to SSPCSP2 or SSPC-SP3 Hand or Power Tool Cleaned surfaces in maintenance situations where mill scale has previously been removed.

Surface Preparation for Under Insulation: SSPC-SP10/NACE 2 Near-White Blast Cleaning or ISO Sa 2 1/2 Very Thorough Blast Cleaning is required.

1st Coat: Series 1528 Endura-Heat DTM	6.0 - 8.0 mils
*2nd Coat: Series 1528 Endura-Heat DTM	<u>6.0 - 8.0 mils</u>
Total Dry Film Thickness: 12.0 - 16.0 mils	

**For mild environments, the 2nd Coat may be omitted.*

Note: Contractor must follow the manufacturer's most recent written recommendations regarding curing procedures.

3.21 SURFACES EXPOSED TO H₂S/H₂SO₄ (SEVERE EXPOSURE/IMMERSION)

The systems listed in this section are designed for severe wastewater exposure. Substrates are exposed to submergence and/or intermittent submergence in severe wastewater conditions. Substrates may also be exposed to H₂S Gas and the biogenic

City of Clearwater

NE WRF MCC-1, DC1 & 2 REPLACEMENT
17-0028-UT
00992-0254

Painting
09 90 00-33

sulfide corrosion process associated with severe wastewater conditions.

A. CEMENTITIOUS SURFACES

1. System No. 434-1: Modified Aliphatic Amine Epoxy Mortar

This system is a 100% solids, hybrid epoxy mortar system designed for severe waste water immersion and fume environments. It is specifically formulated to withstand high levels of hydrogen sulfide gas (H₂S), sulfuric acid (H₂SO₄), as well as other gases common to sewer exposures. Aggregate reinforcement provides additional resistance to abrasions and impacts.

Surface Preparation: Allow new concrete to cure for 28 days. Mechanically abrade per SSPC-SP13/NACE No.6 to remove all laitance, fines, curing compounds, form release oils, and other contaminants, and to establish a surface profile equal to ICRI CSP 5 or greater.

Apply Tnemec Series 218 MortarClad to all surfaces at a minimum of 1/16" to re-surface concrete, fill voids and bugholes, mitigate concrete outgassing, and to create a monolithic, paintable surface.

1st Coat: 434 Perma-Shield	1/8" or 125.0 mils minimum
2nd Coat: 435 Perma-Glaze	<u>18.0 - 20.0 mils</u>
Minimum Dry Film Thickness: 144.0 mils	

Allow coatings to cure for a minimum of 2 days at 75°F prior to service.

2. System No. 436-1: Fiber-Reinforced Modified Polyamine Epoxy

This system provides a thick film, 100% solids, **spray-applied**, high build, abrasion-resistant coating specifically designed for wastewater immersion and fume environments. Provides excellent resistance to H₂S gas permeation, protects against MIC, and provides chemical resistance to severe wastewater environments. Fiber-reinforcement provides superior physical strength and higher film build.

Surface Preparation: Allow new concrete to cure for 28 days. Mechanically abrade per SSPC-SP13/NACE No.6 to remove all laitance, fines, curing compounds, form release oils, and other contaminants, and to establish a surface profile equal to ICRI CSP 5 or greater.

Apply Tnemec Series 218 MortarClad to all surfaces at a minimum of 1/16" to re-surface concrete, fill voids and bugholes, mitigate concrete outgassing, and to create a monolithic, paintable surface.

One Coat: 436 Perma-Shield FR	<u>80.0 - 125.0 mils</u>
Total Dry Film Thickness: 80.0 - 125.0 mils	

Allow coatings to cure for a minimum of 2 days at 75°F prior to service.

B. FERROUS METAL SURFACES

1. System No. 435-1: Modified Polyamine Epoxy

This system provides a versatile, thick film, 100% solids lining specifically designed for wastewater immersion and fume environments. It provides low permeation to H₂S gas, protects against MIC, and provides chemical resistance to severe wastewater environments.

Surface Preparation: SSPC-SP5/NACE No.1 White Metal Blast Cleaning with a minimum 3.0 mil angular anchor profile.

1st Coat: 435 Perma-Glaze	15.0 – 20.0 mils
2nd Coat: 435 Perma-Glaze	<u>15.0 - 20.0 mils</u>
Total Dry Film Thickness: 30.0 - 40.0 mils	
Minimum Dry Film Thickness: 33.0 mils	

Allow coatings to cure for a minimum of 2 days at 75°F prior to service.

2. System No. 431-1: Modified Polyamine Ceramic Epoxy

This system is to be used in severe wastewater exposures where increased abrasion resistance is desired. It is specifically designed for immersion and fume environments and exposure to corrosive soils. It provides low permeation to H₂S gas, protects against MIC, and provides chemical resistance to steel and ductile iron pipe for severe wastewater or buried exposure. It is a coal-tar free, resin-rich formulation with low pigment volume concentration (PVC) for maximum performance.

Surface Preparation: **Steel** - SSPC-SP5/NACE No.1 White Metal Blast Cleaning with a minimum 3.0 mil angular anchor profile. **Ductile Iron Pipe Interiors** - Uniformly abrasive blast using angular abrasive to a NAPF 500-03-04: Internal Pipe Surface condition with a minimum 3.0 mil angular anchor profile. **Ductile Iron Pipe Exteriors** - Uniformly abrasive blast using angular abrasive to a NAPF 500-03-04: External Pipe Surface condition with a minimum 3.0 mil angular anchor profile. **Cast Ductile Fittings** - Uniformly abrasive blast using angular abrasive to a NAPF 500-03-05: Fitting Blast Clean #1 condition with a minimum 3.0 mil angular anchor profile.

One Coat*: 431 Perma-Shield PL	<u>35.0 – 50.0 mils</u>
Total Dry Film Thickness: 35.0 - 50.0 mils	
Minimum Dry Film Thickness: 35.0 mils	

**Series 431 may be applied in two coats to reach the above specified total dry film thickness. Consult the manufacturer's latest written*

recommendations and application guide before applying this product.

Allow Series 431 to cure for 48 hours at 75°F prior to service.

3.22 EXTERIOR OF PRESTRESSED CONCRETE TANKS

A. System No. 156-2: New Tanks

This system provides exceptional elongation, allowing it fill and bridge minor hairline cracks. It also provides mold & mildew resistance, as well as wind-driven rain resistance.

Surface Preparation: Allow new concrete to cure for at least (3) days. Surface to be clean and dry.

1st Coat: Series 156 Envirocrete	4.0 - 6.0 mils
2nd Coat: Series 156 Envirocrete	<u>4.0 - 6.0 mils</u>
Total Dry Film Thickness: 8.0 - 12.0 mils	
Minimum Dry Film Thickness: 10.0 mils	

B. System No. 156-3: Existing Tanks (Previously Painted)

This system provides exceptional elongation for spanning hairline cracks in concrete structures. It also provides mold & mildew resistance, as well as wind-driven rain resistance. Note: If a textured finish is preferred, replace Series 156 with Series 157 Enviro-Crete TX (medium texture) @ 6.0 – 9.0 mils dry film thickness per coat.

Surface Preparation: Remove all dirt, oil, grease, chalk, and loose paint per high pressure water blast (min. 3500 psi).

1st Coat: 151 Elasto-Grip	0.7 - 1.5 mils
Stripe Coat: Use a brush to fill all hairline cracks with Series 156 Envirocrete*	
Topcoat: 156 Envirocrete	<u>6.0 - 8.0 mils**</u>
Total Dry Film Thickness: 6.7 - 9.5 mils***	
Minimum Dry Film Thickness: 7.0 mils	

**Deeper hairline cracks may require multiple brushed coats.*

***Roller or brush application may require multiple coats to obtain recommended film thickness.*

****Total Dry Film thickness does not include stripe coat.*

3.23 SECONDARY CONTAINMENT AREAS

A. System No. 239SC-1: Modified Novolac Epoxy

This system offers superior chemical resistance to a wide range of aggressive chemicals, including Sulfuric Acid, Hydrofluosilicic Acid, Sodium Hydroxide,

City of Clearwater

**NE WRF MCC-1, DC1 & 2 REPLACEMENT
17-0028-UT
00992-0254**

**Painting
09 90 00-36**

Sodium Hypochlorite, Polymer Emulsion, and hydrocarbons. The fiber-reinforced mat within this system provides it with an exceptional ability to bridge the hairline cracks in concrete substrates.

Surface Preparation: Allow new concrete to cure for 28 days. Mechanically abrade per SSPC-SP13/NACE No.6 to remove all laitance, fines, curing compounds, form release oils, and other contaminants, and to establish a surface profile equal to ICRI CSP 5 or greater.

Moisture vapor transmission should not exceed three lbs per 1,000 ft² in a 24 hour period. (Reference ASTM F 1869 "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.") Relative humidity should not exceed 80%. (Reference ASTM F 2170 "Standard Test Method for Determining Relative Humidity in Concrete using in situ Probes.") Note: For moisture content up to 20 lbs per 1,000 ft² or relative humidity up to 99%, Series 241 may be substituted for the primer. Refer to the Series 241 product data sheet for more information.

Apply Tnemec Series 218 MortarClad to all vertical surfaces at a minimum of 1/16" to re-surface concrete, fill voids and bugholes, and to create a monolithic, paintable surface.

Apply Tnemec Series 215 Surfacing Epoxy or Series 218 as needed to fill voids in horizontal surfaces.

Primer: Tnemec Series 239SC RCK	6.0 - 8.0 mils
Basecoat: Tnemec Series 239SC MCK	60.0 - 80.0 mils
Fiberglass Mat: Tnemec Series 211-0215SC	Embedded
Saturant Coat: Tnemec Series 239SC RCK	10.0 - 12.0 mils
Top Coat: Tnemec Series 282*	<u>8.0 - 10.0 mils</u>
Total Dry Film Thickness: 84.0 - 110.0 mils	

**Series 282 is not color stable. For extended color and gloss retention, apply an extra finish coat of Tnemec Series 290 CRU @ 2.0-3.0 mils DFT.*

Note: See Tnemec's Fiberglass Mat Reinforced Mortar Application Guide for System details.

B. System No. 61-1: Cycloaliphatic Amine Epoxy

This system offers excellent resistance to hydrocarbons and chemicals, such as gasoline, diesel fuel, sodium hydroxide, ferric chloride, and sodium hypochlorite. Use Tnemec Series 215 Surfacing Epoxy between coats as a filler and surfacer if required.

Surface Preparation: Allow new concrete to cure for 28 days. Mechanically abrade per SSPC-SP13/NACE No.6 to remove all laitance, fines, curing compounds, form release oils, and other contaminants, and to establish a surface profile equal to ICRI CSP 5 or greater.

Moisture vapor transmission should not exceed three lbs per 1,000 ft² in a 24 hour period. (Reference ASTM F 1869 "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.") Relative humidity should not exceed 80%. (Reference ASTM F 2170 "Standard Test Method for Determining Relative Humidity in Concrete using in situ Probes.") Note: For moisture content up to 20 lbs per 1,000 ft² or relative humidity up to 99%, Series 241 may be applied prior to the "Primer" coat. Refer to the Series 241 product data sheet for more information.

Apply Tnemec Series 218 MortarClad to all **vertical** surfaces at a minimum of 1/16" to re-surface concrete, fill voids and bugholes, mitigate concrete outgassing, and to create a monolithic, paintable surface.

Apply Tnemec Series 215 Surfacing Epoxy or Series 218 MortarClad as needed to fill voids in **horizontal** surfaces.

Primer: 61-5002 Tneme-Liner (Beige)	8.0 - 12.0 mils
Topcoat: 61-5001 Tneme-Liner (Gray)	<u>8.0 - 12.0 mils</u>
Total Dry Film Thickness: 16.0 - 24.0 mils	
Minimum Dry Film Thickness: 18 mils	

3.24 PIPE EXTERIOR COATING SYSTEMS

The coating systems in the PIPE EXTERIOR COATING SYSTEMS section are not intended for use over bitumastic coatings. Do not apply bitumastic prior to the application of any of these systems.

- A. System No. 700-2: Zinc/Epoxy/Fluoropolymer (Pipes at Aerial Crossings or Similarly Difficult to Maintain Areas)

This system provides outstanding resistance to ultra-violet light degradation and extremely good color and gloss retention. This system will have excellent resistance to abrasion and chalking, and is recommended for coastal environments and on structures where extremely long-term maintenance cycles are desired. This system is to be applied to new steel pipes or existing steel pipes which require removal of existing coatings. (Note: Series 700 is gloss. If the Owner desires a semi-gloss finish then Series 700 may be replaced with Series 701.) Note: For single-component application, Series 90G-1K97 may be substituted as the primer.

Surface Preparation: **Steel** - SSPC-SP6/NACE No.3 Commercial Blast Cleaning with a minimum 1.5 mil angular anchor profile. **Ductile Iron Pipe** - Uniformly abrasive blast using angular abrasive to a NAPF 500-03-04: External Pipe Surface condition. **Cast Ductile Fittings** - Uniformly abrasive blast using angular abrasive to a NAPF 500-03-05: Fitting Blast Clean #3 condition.

Primer: Series 90-97 Tneme-Zinc	2.5 - 3.5 mils
2nd Coat: Series 66 Hi-Build Epoxoline	2.0 - 6.0 mils
3rd Coat: Series 700 Hydroflon	<u>2.0 - 3.0 mils</u>

Total Dry Film Thickness: 6.5 - 12.5 mils
Minimum Dry Film Thickness: 8.0 mils

B. System No. N140-2: Epoxy/Epoxy/Epoxy or Urethane (Standard DIP System)

This system provides exceptional corrosion protection in atmospheric, immersion, and buried environments. This system is to be applied to new pipes. The 3rd coat is dependent on the exposure – for buried areas use an extra coat of high-solids epoxy, for uv-exposed, non-immersion areas use an aliphatic acrylic urethane. Series 1095 has a semi-gloss finish. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

Surface Preparation: **Steel** - SSPC-SP6/NACE No.3 Commercial Blast Cleaning with a minimum 1.5 mil angular anchor profile. **Ductile Iron Pipe** - Uniformly abrasive blast using angular abrasive to a NAPF 500-03-04: External Pipe Surface condition. **Cast Ductile Fittings** - Uniformly abrasive blast using angular abrasive to a NAPF 500-03-05: Fitting Blast Clean #3 condition.

NOTE: If NSF Std. 61 compliance is required, Series N69 may NOT be used. Instead, use Series N140.

Shop Primer: Series N140 Pota-Pox Plus	2.0 – 10.0 mils
2nd Coat: Series N140 or Series N69	4.0 - 10.0 mils
3rd Coat (Buried or Immersion Areas Only):	
Series N140 or Series N69	4.0 - 10.0 mils
3rd Coat (UV Exposed, Non-immersion Areas Only):	
Series 1095	<u>2.5 - 5.0 mils</u>
Total Dry Film Thickness:	10.0 – 30.0 mils
Minimum Dry Film Thickness:	11.0 mils

C. System No. 46H-413-4: Polyamide Epoxy-Coal Tar (Buried Pipes Only)

This system provides a high-build coating for underground conditions.

Surface Preparation: **Steel** - SSPC-SP6/NACE No.3 Commercial Blast Cleaning with a minimum 1.5 mil angular anchor profile. **Ductile Iron Pipe** - Uniformly abrasive blast using angular abrasive to a NAPF 500-03-04: External Pipe Surface condition. **Cast Ductile Fittings** - Uniformly abrasive blast using angular abrasive to a NAPF 500-03-05: Fitting Blast Clean #3 condition.

1st Coat: Series 46H-413 Hi-Build Thene-Tar	8.0 - 10.0 mils
2nd Coat: Series 46H-413 Hi-Build Thene-Tar	<u>8.0 - 10.0 mils</u>
Total Dry Film Thickness:	16.0 - 20.0 mils
Minimum Dry Film Thickness:	18.0 mils

D. System No. 1095-5: Acrylic Polyurethane (PVC or HDPE Pipe)

This system provides a user friendly, low VOC, aliphatic acrylic polyurethane coating which offers excellent color and gloss retention. Series 1095 has a semi-

gloss finish. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

Surface Preparation: SSPC-SP1 followed by hand or power sanding to thoroughly and uniformly scarify and de-gloss the surface.

1st Coat: Series 66 Hi-Build Epoxoline	2.0 – 3.0 mils
2nd Coat: Series 1095 EnduraShield	<u>2.5 – 5.0 mils</u>
Total Dry Film Thickness: 4.5 – 8.0 mils	
Minimum Dry Film Thickness: 5.0 mils	

E. System No. 1026-4: Acrylic Emulsion (Interior Exposed, Insulated Pipe)

Surface Preparation: Surface shall be clean and dry.

1st Coat: Series 1026 Enduratone	2.0 - 3.0 mils
2nd Coat: Series 1026 Enduratone	<u>2.0 - 3.0 mils</u>
Total Dry Film Thickness: 4.0 - 6.0 mils	
Minimum Dry Film Thickness: 5.0 mils	

F. System No. 700-3: Epoxy Mastic/Fluoropolymer (Overcoat) (Existing, Previously Coated Aerial Pipes or Similarly Difficult to Maintain Areas)

This system provides outstanding resistance to ultra-violet light degradation and extremely good color and gloss retention. This system will have excellent resistance to abrasion and chalking, and is recommended for coastal environments and on structures where extremely long-term maintenance cycles are desired. This system is to be used for overcoating existing steel pipes whose surfaces have some rust present. (Note: Series 700 is gloss. If the Owner desires a semi-gloss finish then Series 700 may be replaced with Series 701.)

Surface Preparation: High Pressure Water Clean (min. 3500 psi, 3 to 5 gallons per minute, using an oscillating tip and potable water). A cleaning detergent such as Trisodium Phosphate should be used to facilitate cleaning. A degreaser may be required for oil soaked areas or heavily contaminated areas.

Some spot areas may require Hand Tool (SSPC-SP2), Power Tool Cleaning (SSPC-SP3), or Brush Blast (SSPC-SP7/NACE No. 4) to remove loose surface rust.

Existing coatings must be clean, dry and tightly adhering prior to application of coatings.

Spot Prime (Areas of Bare Steel): Series 135 Chembuild	4.0 - 6.0 mils
1st Coat: Series 135 Chembuild	4.0 - 6.0 mils
2nd Coat: Series 700 Hydroflon	<u>2.0 - 3.0 mils</u>
Total Dry Film Thickness: 6.0 – 9.0 mils*	
Minimum Dry Film Thickness: 7.0 mils	

*Does not include Spot Prime or previously existing coatings

G. System No. 1095-6: Epoxy Mastic/Urethane (Overcoat) (Existing Pipes Previously Coated with High Performance Coatings)

This system can be used over factory finish paint or over non-sandblasted steel and offer the high performance of a urethane coating. Series 1095 has a semi-gloss finish. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

Surface Preparation: High Pressure Water Clean (min. 3500 psi, 3 to 5 gallons per minute, using an oscillating tip and potable water). A cleaning detergent such as Trisodium Phosphate should be used to facilitate cleaning. A degreaser may be required for oil soaked areas or heavily contaminated areas.

Some spot areas may require Hand Tool (SSPC-SP2), Power Tool Cleaning (SSPC-SP3), or Brush Blast (SSPC-SP7/NACE No. 4) to remove loose surface rust.

Existing coatings must be clean, dry, and tightly adhering prior to application of coatings.

Spot Prime (Areas of Bare Steel): Series 135 Chembuild	4.0 – 6.0 mils
1st Coat: Series 135 Chembuild	4.0 - 6.0 mils
2nd Coat: Series 1095 Endura-Shield	<u>2.5 - 5.0 mils</u>

Total Dry Film Thickness: 6.5 - 11.0 mils*

Minimum Dry Film Thickness: 7.0 mils

**Does not include spot prime or previously existing coatings.*

3.25 INSULATIVE COATINGS – THERMAL RESISTANCE

A. SUBSTRATES UP TO 325°F

1. System No. 971-1: Personnel Protection

This system utilizes fluid-applied aerogel particles to **provide “safe touch,” allowing a minimum 5 seconds of skin contact with the substrate (up to 325°F). This ideal for hot pipes, valves, tanks, etc.** This coating system eliminates the corrosion under insulation (CUI) issues associated with traditional insulations. **This system negates the need for a mineral wool + aluminum jacket system.**

Surface Preparation: SSPC-SP6/NACE No. 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.*

1 st Coat: Series 1224 Epoxoline WB	5.0 – 8.0 mils
2 nd Coat: Series 971 Aerolon Acrylic	50.0 mils
3 rd Coat: Series 971 Aerolon Acrylic	50.0 mils

4th Coat: Series 72T EnduraShield 2.0 – 5.0 mils
 Total Dry Film Thickness: 107.0 – 113.0 mils
 Minimum Dry Film Thickness: 109.0 mils

**Abrasive blast cleaning generally produces the best coating performance. If conditions will not permit this, Series 1224 may be applied to SSPC-SP2 or SSPC-SP3 Hand or Power Tool Cleaned surfaces.*

B. SUBSTRATES BELOW AMBIENT TEMPERATURE

1. System No. 971-2: Condensation Control (Sweating Substrates)

This system utilizes Series 971’s fluid-applied aerogel particles and hydrophobic properties to **mitigate condensation on otherwise wet, “sweating” surfaces**. This is ideal for pipes, valves, and other substrates which have temperatures that create condensation (but do not freeze). **This system negates the need for a mineral wool + aluminum jacket system.**

Surface Preparation: SSPC-SP6/NACE No. 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.*

1 st Coat: Series 1224 Epoxoline WB	5.0 – 8.0 mils
2 nd Coat: Series 971 Aerolon Acrylic	50.0 mils
3 rd Coat: Series 971 Aerolon Acrylic	50.0 mils
4 th Coat: Series 72T EnduraShield	2.0 – 5.0 mils
Total Dry Film Thickness: 107.0 – 113.0 mils	
Minimum Dry Film Thickness: 109.0 mils	

**Abrasive blast cleaning generally produces the best coating performance. If conditions will not permit this, Series 1224 may be applied to SSPC-SP2 or SSPC-SP3 Hand or Power Tool Cleaned surfaces.*

2. System No. 971-3: Condensation Control (Freezing Substrates)

This system utilizes Series 971’s fluid-applied aerogel particles and hydrophobic properties to **mitigate condensation on surfaces that would otherwise ice & freeze over**. This is ideal for pipes, valves, and other substrates which have temperatures & condensation that are creating ice on the substrate. This coating system will significantly reduce/eliminate ice formations. **This system negates the need for a mineral wool + aluminum jacket system.**

Surface Preparation: SSPC-SP6/NACE No. 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.*

1 st Coat: Series 1224 Epoxoline WB	5.0 – 8.0 mils
2 nd Coat: Series 971 Aerolon Acrylic	50.0 mils
3 rd Coat: Series 971 Aerolon Acrylic	50.0 mils
4 th Coat: Series 971 Aerolon Acrylic	50.0 mils
5 th Coat: Series 72T EnduraShield	2.0 – 5.0 mils

Total Dry Film Thickness: 157.0 – 163.0 mils
Minimum Dry Film Thickness: 159.0 mils

**Abrasive blast cleaning generally produces the best coating performance. If conditions will not permit this, Series 1224 may be applied to SSPC-SP2 or SSPC-SP3 Hand or Power Tool Cleaned surfaces.*

3.26 PERFORMANCE CRITERIA

The following shall serve as a basis of comparison for material substitution requests. Any substitutions which decrease the total film thickness, change the generic type of coating, or fail to meet the performance criteria of the specified materials shall not be approved.

- A. Series 1 Omnithane - Zinc/Micaceous Iron Oxide Urethane:
- Adhesion: ASTM D4541 (Method B, Type II) - No less than 1,433 psi (9.88 MPa) adhesion, average of three tests.
 - Salt Spray (Fog): ASTM B117 - No blistering, cracking or delamination of film. No more than .03% rusting on plane and no more than 3/16" rust creepage at scribe after 10,000 hours exposure.
- B. Series 20 Pota-Pox – Polyamide Epoxy:
- Special Qualification: Certified by NSF International in accordance with NSF/ANSI Std. 61.
 - Abrasion: ASTM D4060 (CS-17 Wheel, 1,000 gram load) - No more than 115 mg loss after 1,000 cycles with 1,000 gram load, average of three tests
 - Adhesion: ASTM D4541 - No less than 1,930 psi (13.31 MPa) pull, average of three tests.
 - Salt Spray: ASTM B117 (2 Coats Series 20) - No blistering, cracking, checking or delamination of film. No more than 1/8" rust creepage at scribe after 8,000 hours exposure.
- C. Series 22 Epoxoline – Modified Polyamine Epoxy:
- Special Qualification: Certified by NSF International in accordance with NSF/ANSI Std. 61.
 - Product must be able to be applied in one single-coat application from 16.0 to 40.0 mils dry film thickness.
 - VOC Content: 0.10 lbs/gallon (12 grams/litre)
 - Immersion: ASTM 870 – No blistering, cracking, rusting or delamination of film after 2,000 hours continuous immersion in deionized water at 140°F (60°C), average of three tests.
- D. Series 27WB Typoxy - Inorganic Hybrid Water-Based Epoxy:
- VOC Content: 0.01 lbs/gallon (0.9 grams/litre)
 - Adhesion: ASTM D4541 (Type V Tester) - No less than 1,440 psi (9.93 MPa) pull, average of three tests.
 - Cyclic Salt Fog/UV Exposure: ASTM D5894 - No blistering, cracking, rusting or delamination of film after 3,000 hours continuous exposure, average of

- three tests.
 - Salt Spray: ASTM B117 - No blistering, cracking, rusting or delamination of film. No more than 3/16 inch rust creepage at scribe after 6,200 hours exposure.
- E. Series 46H-413 Hi-Build Tneme-Tar – Polyamide Epoxy-Coal Tar:
- Adhesion: ASTM D4541 - Exceeds the cohesive strength of the concrete substrate (400 psi), average of three tests.
 - Abrasion: ASTM D4060 (CS-17 wheel, 1,000 gram load) - No more than 142 mg loss after 1,000 cycles.
 - Salt Spray (Fog): ASTM B117 - No blistering, cracking, checking, rusting or delamination of film. No rust creepage at scribe after 9,000 hours continuous exposure.
- F. Series 61 Tneme-Liner – Cycloaliphatic Amine Epoxy:
- Chemical Immersion: NACE TM-01-74, Procedure B – No blistering, cracking, rusting or delamination of film after six months continuous immersion.
 - Immersion: ASTM D870 - No blistering, cracking or delamination of film after 12 months continuous immersion in deionized water at 200°F (93°C).
- G. Series 66 Hi-Build Epoxoline – Polyamide Epoxy:
- Adhesion: ASTM D4541 – No less than 1,930 psi (13.31 MPa) pull, average of three tests.
 - Salt Spray: ASTM B117 (2 Coats Series 66) - No blistering, cracking, checking or delamination of film. No more than 1/8" rust creepage at scribe after 8,000 hours exposure.
- H. Series N69 Hi-Build Epoxoline II – Polyamidoamine Epoxy:
- Adhesion: ASTM D4541 – No less than 1,943 psi (13.40 MPa) pull, average of three tests.
 - Exterior Exposure: ASTM D1014 - No blistering, cracking, checking, rusting or delamination of film. No rust creepage at scribe after 5 years exposure.
 - Humidity: ASTM D4585 - No blistering, cracking, checking, rusting or delamination of film after 10,000 hours exposure.
 - Immersion: ASTM D870 - No blistering, cracking, rusting or delamination of film after 2,000 hours continuous immersion in deionized water at 140°F, average of three tests.
 - Salt Spray: ASTM B117 (2 Coats Series N69) - No blistering, cracking or delamination of film. No more than 1% rusting on plane. No more than 1/16" rust creepage at scribe after 6,700 hours exposure.
 - Salt Spray: ASTM B117 (Series 90-97 with 2 Coats Series N69) - No blistering, cracking, rusting or delamination of film. No more than 1% rusting on plane. No more than 3/16" rust creepage at scribe after 20,000 hours exposure.
- I. Series 90-97 Tneme-Zinc – Aromatic Zinc-Rich Urethane:
- Zinc Pigment: 83% by weight in dried film

- Adhesion: ASTM D4541 (Type II) - No less than 1,442 psi (9.94 MPa) adhesion, average of three tests.
 - Salt Spray: ASTM B117 - No blistering, cracking or delamination of film. No more than 1/8" creepage at scribe and no more than 1% rusting on plane after 50,000 hours exposure.
- J. Series 94H₂O Hydro-Zinc – Zinc-Rich Aromatic Urethane
- Special Qualification: Certified in accordance with ANSI/NSF Std. 61 for use on interior potable water tanks of 500 gallons or greater.
 - Zinc Pigment: 83% by weight in dried film.
 - Adhesion: ASTM D4541 (Type V Self-Aligning Adhesion Tester): No less than 1,713 psi adhesion, average of three tests.
 - Salt Spray: ASTM B117 - No blistering, cracking or delamination of film. No rusting on plane and no more than 1/16" rust creepage at scribe after 10,000 hours.
- K. Series 104 HS Epoxy – Cycloaliphatic Amine Epoxy:
- Adhesion: ASTM D4541 – No less than 900 psi (6.21 MPa) pull, average of three tests.
 - Chemical Immersion: NACE TM-01-74, Procedure B – No blistering, cracking or delamination of film after seven days.
 - Salt Spray (Fog): ASTM B117 - No blistering, cracking, rusting or delamination of film. No more than 1/32" (.8 mm) rust creepage at scribe after 1,500 hours exposure.
- L. Series 113 Tneme-Tufcoat – Waterborne Acrylic Epoxy:
- Adhesion: ASTM D4541 - No less than 380 psi (2.6 MPa) pull, average of three tests (applied directly to concrete block).
 - Humidity: ASTM D2247 - No blistering, cracking or delamination after 1,000 hours exposure.
- M. Series 115 Uni-Bond DF – Self-Crosslinking Hydrophobic Acrylic:
- Adhesion: ASTM D4541 (Method C – Type V Tester) - No less than 1,472 psi pull (10.15 MPa), average of three tests
 - Salt Spray: ASTM B117 - No more than 1/64" rust creepage at scribe, no more than 3% rusting on plane and no less than a blister rating of 8 after 500 hours exposure.
 - Humidity: ASTM D4585 - No blistering, cracking, rusting or delamination of film after 2,000 hours exposure.
- N. Series 135 Chembuild – Modified Polyamidoamine Epoxy:
- Adhesion: ASTM D4541 (Type II, Method B) - No less than 883 psi (5.86 MPa) pull, average of three tests.
- O. Salt Spray: ASTM B117 (Two coats, applied to SSPC-SP10/NACE No.2 Near-White Metal Blast Cleaned steel which was exterior exposed for four months until uniformly rusted, then SSPC-SP2 Hand Tool Cleaned) – No blistering, cracking, rusting or delamination of the film and no creepage at the scribe after 4000 hours

- P. Series N140 Pota-Pox Plus – Polyamidoamine Epoxy:
- Adhesion: ASTM D4541 - No less than 1,943 psi (13.40 MPa) pull, average of three tests.
 - Exterior Exposure: ASTM D1014 - No blistering, cracking, checking, rusting or delamination of film. No rust creepage at scribe after 5 years exposure.
 - Humidity: ASTM D4585 - No blistering, cracking or delamination of film after 10,000 hours exposure.
 - Immersion: ASTM D870 - No blistering, cracking, rusting or delamination of film after 2,000 hours continuous immersion in deionized water at 140°F, average of three tests.
 - Salt Spray (Fog): ASTM B117 (2 Coats Series N140) - No blistering, cracking or delamination of film. No more than 1% rusting on plane. No more than 1/16" rust creepage at scribe after 6,700 hours exposure.
 - Salt Spray (Fog): ASTM B117 (Series 91H₂O and 2 Coats Series N140) - No blistering, cracking, checking or delamination of film. No more than 1% rusting on plane and no more than 3/16" rust creepage at scribe after 20,000 hours exposure.
- Q. Series 142 Epoxoline – Modified Polyamine Epoxy:
- Adhesion: ASTM D4541 - No less than 2,042 psi (14.08 MPa) pull, average of three tests.
 - Salt Spray (Fog): ASTM B117 - No blistering, cracking, rusting or delamination of film and less than 1/32 inch creepage at the scribe after 5,000 hours exposure.
 - Abrasion: ASTM D4060 - No more than 59.3 mg loss after 1,000 cycles, average of two tests.
- R. Series 156 Enviro-Crete – Modified Waterborne Acrylate:
- Adhesion: ASTM D7234 – Exceeds the cohesive strength of concrete substrate (400 psi), average of three tests.
 - Salt Spray: ASTM B117 - No blistering, cracking or delamination of film. No visible damage to coating or substrate after 5,000 hours.
 - QUV Exposure: ASTM D4587 (UVA-340 bulbs, 8 hours UV, 4 hours condensation) - No blistering, cracking, chalking or delamination of the film. No less than 69% gloss retention, no more than 1.1 units gloss loss, and no more than 3.59 DE (FMC-2) color change (white) after 5,000 hours QUV exposure.
 - Fungal/Mold/Mildew Resistance: ASTM D3273 – No More than slight mold growth after five weeks exposure.
 - Tensile Strength, Elongation, Modulus of Elasticity: ASTM D2370 - Elongation no less than 200 percent, average of five tests. Tensile strength no less than 250 psi (1.7 MPa), average of three tests.
 - Wind Driven Rain Resistance: FED TT-C-555B, Section 4.4.7.3 - No damage to coating or substrate. No visible moisture on the back of lightweight block after 48 hours exposure.
- S. Series 201 Epoxoprime – Modified Polyamine Epoxy:
- Adhesion: ASTM D4541 - 400 psi (2.8 MPa) pull, average of three tests.

- 100% Concrete Failure.
 - Compressive Strength: ASTM D695 - 6,866 psi (47.34 MPa) compressive strength unfilled
 - Flexural Strength and Modulus of Elasticity: ASTM D790 - 12,873 psi (88.76 MPa) flexural strength average of five tests. 553,832 psi (3,818.54 MPa) flexural modulus, average of five tests.
 - Tensile Strength: ASTM D638 - 4,871 psi (33.59 MPa) tensile strength, average of five tests.
- T. Series 215 Surfacing Epoxy – Modified Polyamine Epoxy
- Special Qualification: Certified in accordance with ANSI/NSF Std. 61 for use on interior potable water tanks of 200 gallons or greater at 80 mils DFT
 - VOC Content: 0.08 lbs/gallon
 - Adhesion: ASTM D7234 (Method B): Exceeds the cohesive strength of the concrete substrate (400 psi).
 - Adhesion: ASTM D4541 – Not less than 2,226 psi (15.35 MPa) pull, average of three tests.
 - Compressive Strength: ASTM C579 – No less than 9,183 psi (63.3 MPa) compressive strength, average of five tests.
 - Flexural Strength and Modulus of Elasticity: C580 – No less than 4,330 psi (29.9 MPa) flexural strength and 324,877 psi (2,240 MPa) flexural modulus of elasticity, average of six tests.
 - Flexural Strength and Modulus of Elasticity: ASTM D790 – No less than 10,630 psi (73.29 MPa) flexural strength and 87,440 psi (602.88 MPa) flexural modulus of elasticity, average of three tests.
 - Tensile Strength, Elongation, Modulus of Elasticity: ASTM C307 – No less than 2,280 psi (15.72 MPa) tensile strength, average of six tests.
 - Tensile Strength, Elongation, Modulus of Elasticity: ASTM D2370 – No less than 2,011 psi (13.86 MPa) tensile strength, 304,213 psi (2,102 MPa) tensile modulus of elasticity and 1.04% elongation, average of ten tests.
 - Water Absorption: ASTM C413 – No weight gained after 2 hours continuous boiling water immersion, average of three tests.
- U. Series 217 Mortarcrete – Cementitious Repair Mortar:
- VOC Content: 0.0 lbs/gallon
 - Compressive Strength: ASTM C579 – No less than 10,650 psi (73.43 MPa) compressive strength, average of three tests.
 - Density: ASTM C188 – 2.13 g/cm³ (133 pcf) density.
 - Drying Shrinkage: ASTM C596 – No more than 0% drying shrinkage, average of four specimens.
 - Set Times: ASTM C266 – Fresh Mortar Properties: Initial Setting Time - 65 minutes; Final Setting Time - 80 minutes.
 - Splitting Tensile Strength: ASTM C496 – No less than 850 psi (5.86 MPa) splitting tensile strength, average of three tests.
 - Thermal Expansion: ASTM C531 – No more than 7.46 X 10⁻⁶ linear coefficient of thermal expansion in/in/°F, average of three tests.

- V. Series 222 Deco-Tread – Colored Quartz-Filled Modified Polyamine Epoxy:
- Compressive Strength: ASTM C579 - 15,567 psi (107.33 MPa) compressive strength.
 - Flexural Strength and Modulus of Elasticity: ASTM D790 - No less than 2,867 psi (19.77 MPa) flexural strength and 127,876 psi (881.67 MPa) flexural modulus of elasticity, average of five tests.
 - Tensile Strength: ASTM C307 - 2,100 psi (14.5 MPa) tensile strength, average of three tests.
 - Thermal Expansion: ASTM C531 - No more than 1.85×10^{-5} linear coefficient of thermal expansion per °F, average of two rounds of six tests.
- W. Series 237 Power-Tread – Modified Polyamine Epoxy:
- Flexural Strength and Modulus of Elasticity: ASTM D790 - 5,274 psi (36.4 MPa) flexural strength and 222,933 psi (1,537 MPa) flexural modulus of elasticity, average of five tests.
 - Impact: Mil D3134 - No more than 1/16" permanent indentation. No cracking, checking or delamination of film after 240 in-lb (27 J) direct impact.
- X. Series 239SC Chembloc – Modified Novolac Polyamine Epoxy:
- Chemical Immersion: NACE TM-01-74, Procedure B – No blistering, cracking, rusting or delamination of film after 72 hours continuous contact with chemical.
 - Compressive Strength: ASTM C579 - Not less than 11,195 psi (77.19 MPa) compressive strength, average of six tests.
 - Flexural Strength and Modulus of Elasticity: ASTM D790 - Not less than 6,270 psi (43.23 MPa) flexural strength and 323,900 psi (2,233 MPa) flexural modulus of elasticity, average of five tests.
 - Impact: MIL D3134 (modified using 2.5 lb steel ball) - No more than 1/16" permanent indentation. No cracking, checking or delamination of film after 240 in-lb (27 J) direct impact, average of three tests.
 - Tensile Strength, Elongation, Modulus of Elasticity: ASTM D638 - No less than 7,913 psi (54.56 MPa) tensile strength, 222,975 psi (1,537 MPa) tensile modulus of elasticity and 6.14% elongation at break.
- Y. Series 241 Ultra-Tread MVT – Polyurethane Modified Concrete:
- Can be applied to 10 day old concrete
 - Withstands moisture vapor transmission up to 20 lbs per ASTM F1869
 - Withstands relative humidity up to 99% per ASTM F2170
 - Adhesion: ASTM D7234 - Exceeds the cohesive strength of the concrete substrate (~400 psi), average of three tests.
 - Compressive Strength: ASTM C579 - No less than 4,922 psi (33.94 MPa) compressive strength, average of six tests.
 - Flexural Strength and Modulus of Elasticity: ASTM C580 - No less than 2,438 psi (16.81 MPa) flexural strength and 313,614 psi (2,162 MPa) modulus of elasticity (tangent), average of five tests.
 - Tensile Strength: ASTM C307 - No less than 1,015 psi (7.00 MPa) tensile strength, average of six tests.

- Z. Series 248 Everthane – Aliphatic Moisture Cured Urethane:
- Chemical Resistance: TTM-59 (Covered Spot Test) - No blistering, cracking, checking or delamination of film. No more than slight softening or very slight swelling and loss of gloss after 24 hours exposure to the following reagents: 30% Sulfuric Acid, 10% Hydrochloric Acid, 50% Phosphoric Acid, 10% Acetic Acid, 50% Sodium Hydroxide, 10% Ammonium Hydroxide, Methyl Ethyl Ketone, Ethyl Alcohol, Hexane, Xylene, Gasoline, Ethylene Glycol, Skydrol, Brake Fluid, Transmission Fluid, Aviation Gas, Jet Fuel (JP4)
 - Abrasion: ASTM D4060 (CS-17 Wheel, 1,000 gram load) – No more than 18 mg loss after 1,000 cycles, average of three tests.
- AA. Series 262 Elasto-Shield – Modified Polyurethane:
- Abrasion: ASTM D4060 (CS-17 Wheel, 1,000 grams load) – No more than 1.2 mg loss after 1,000 cycles.
 - Deflection Temperature: ASTM D648 – (Minimum use temp) Below -60°F (-15°C).
 - Flexibility and Elongation: ASTM D522 – Must pass 1/8” bend with no cracking or delamination.
 - Tear Strength: ASTM D624 – 150 lbs/inch.
 - Tensile Strength, Elongation, Modulus of Elasticity: ASTM D412 – Requirement: (extension to break) 400%. 900 psi.
- BB. Series 264 Elasto-Shield – Modified Polyurethane:
- Special Qualification: Certified by NSF International in accordance with NSF/ANSI Std. 61. Maximum contact area is 20 cm² per litre of water, with minimum allowable size of tanks 5,000 gallons; cold water applications.
 - Abrasion: ASTM D4060 (CS-17 Wheel, 1,000 grams load) – No more than 1.2 mg loss after 1,000 cycles.
 - Deflection Temperature: ASTM D648 – (Minimum use temp) Below -60°F (-15°C).
 - Flexibility and Elongation: ASTM D522 – Must pass 1/8” bend with no cracking or delamination.
 - Tear Strength: ASTM D624 – 180 lbs/inch.
 - Tensile Strength, Elongation, Modulus of Elasticity: ASTM D412 – Requirement: (extension to break) 300%. 1,000 psi.
- CC. Series 282 Tneme-Glaze – Polyamine Novolac Epoxy:
- Chemical Immersion: NACE TM-01-74, Procedure B – No blistering, cracking, rusting or delamination of film after 72 hours continuous contact with chemical.
 - Compressive Strength: ASTM C579 - Not less than 11,195 psi (77.19 MPa) compressive strength, average of six tests.
 - Immersion: 140°F Deionized Water Immersion - No blistering, cracking, rusting or delamination of film after 2,000 hours continuous immersion.
 - Impact: ASTM D2794 - No visible cracking or delamination of film after 59 in/lbs direct impact, average of three tests.

- Salt Spray (Fog) – ASTM B117 - No blistering, cracking, rusting or delamination of film. No more than 1/16 inch rust creepage at scribe after 3,500 hours exposure.
- DD. Series 284 Deco-Clear – Modified Polyamine Epoxy:
- Coefficient of Friction: ASTM D2047 - 1.2 static coefficient of friction, average of 12 tests.
 - Flexural Strength and Modulus of Elasticity: ASTM D790 - 2,867.1 psi (19.768 MPa) flexural strength average of five tests. 127,876 psi (881.67 MPa) flexural modulus, average of five tests.
 - Impact: ASTM D2794 - 160 inch pounds (18.08 J) average, direct impact.
 - Tensile Strength: ASTM D638 - 2,182.9 psi (15.1 MPa) tensile strength, average of five tests.
- EE. Series 287 Enviro-Pox – Waterborne Epoxy-Amine Adduct:
- Adhesion: ASTM D4541 - Exceeds the cohesive strength of the concrete substrate (400 psi), average of three tests.
 - Impact: ASTM D2794 - No visible cracking or delamination of film after 60 in-lb (6.8 J) direct impact, average of three tests.
 - Abrasion: ASTM D4060 (CS-17 Wheel, 1,000 grams load) - No more than 113.3 mg loss after 1,000 cycles, average of three tests.
- FF. Series 365 Tank Armor – Novolac Epoxy:
- Adhesion: ASTM D4541, Type II – No less than 1,650 psi (11.38 MPa) adhesion, average of three tests.
 - Hardness: ASTM D2240 (Shore D Durometer) – Not less than 90 Shore Type D hardness, average of five tests.
- GG. Series 431 Perma-Shield PL – Modified Polyamine Ceramic Epoxy:
- Severe Wastewater Analysis Test: ASTM G210 - Initial impedance of 11.18 log-Z at 0.001 Hz (ohms cm²). No blistering, cracking, checking or delamination. No less than 88.7% EIS retention or not more than 1.26 ohms cm² reduction in log-Z electrochemical impedance at 0.001 Hz after 28 days exposure. No less than 2,363 psi (16.30 MPa) adhesion or no loss of adhesion after 28 days in S.W.A.T., average of three tests.
 - Abrasion Resistance: ASTM D4060-14 (CS-17 Wheel, 1,000 cycles, 1,000 gram load) – No more than 41 mg loss, average of three tests.
 - Abrasion Resistance: BS EN 598: 2007+A1: 2009 (Rocking Abrasion) - No more than 0.14 mm (5.5 mils) thickness of coating loss after 1,000,000 cycles.
- HH. Series 434 Perma-Shield H₂S – Modified Aliphatic Amine Epoxy Mortar:
- Severe Wastewater Analysis Test: ASTM G210 - Initial impedance of 10.6 log-Z at 0.01 Hz (ohms cm²). No blistering, cracking or checking. No less than 86.7% retention or not more than 1.4 ohms cm² reduction in log-Z electrochemical impedance at 0.01 Hz after 28 days exposure.
 - Abrasion Resistance: ASTM D4060 (CS-17 Wheel, 1,000 gram load) – No more than 88 mg loss after 1,000 cycles, average of three tests.

- Impact: ASTM D2794 – No visible cracking or delamination after 160 inch-pounds (18.1 J) direct impact.
 - Compressive Strength: ASTM D695 – Not less than 12,331 psi (85.0 MPa) compressive strength, average of five tests.
- II. Series 435 Perma-Glaze – Modified Polyamine Epoxy:
- Severe Wastewater Analysis Test: ASTM G210 - Initial impedance of 12.46 log-Z at 0.01 Hz (ohms cm²). No blistering, cracking, checking or delamination. No less than 84.3% retention and no more than 1.95 ohms cm² reduction in electrochemical impedance after 28 days exposure. No less than 93% loss of tensile adhesion after 28 days in S.W.A.T. average of three tests.
 - Abrasion Resistance: ASTM D4060 (CS-17 Wheel, 1,000 gram load) – No more than 72 mg loss after 1,000 cycles, average of three tests.
- JJ. Series 436 Perma-Shield FR – Fiber-Reinforced Modified Polyamine Epoxy:
- Severe Wastewater Analysis Test: ASTM G210 - Initial impedance of 10.2 log-Z at 0.01 Hz (ohms cm²). No blistering, cracking or checking. No less than 83.7% retention or not more than 1.6 ohms cm² reduction in log-Z electrochemical impedance at 0.01 Hz after 28 days exposure.
 - Abrasion: ASTM D4060 (CS-17 Wheel, 1,000 gram load) – No more than 74.6 mg loss after 1,000 cycles, average of three tests.
 - Impact: ASTM D2794 – No visible cracking or delamination of film after 88 inch-pounds direct impact.
 - Compressive Strength: ASTM D695 – No less than 8,866 psi (6.13 MPa) compressive strength, average of five tests.
- KK. Series 446 Perma-Shield MCU – Hydrophobic Aromatic Polyurethane:
- Minimum Time to Return to Immersion Service: 4 Hours
 - Severe Wastewater Analysis Test: ASTM G210 - Initial impedance of 10.2 (log-Z). No blistering, cracking, checking or loss of adhesion. No more than 0.1 (log-Z) reduction in electrical impedance after 28 days exposure.
- LL. Series 626 Dur A Pell GS – RTV Silicone Rubber Water & Graffiti Protectant:
- Accelerated Weathering: ASTM C793 - No signs of deterioration except for dirt accumulation after 4,000 hours exposure.
 - Chloride Ion Penetration: AASHTO T-259 - No less than a 1500% reduction in the chloride ion content when compared to untreated concrete, average of two tests.
- MM. Series 662 Prime-A-Pell Plus – Modified Siloxane/Silane with Diffused Quartz Carbide:
- QUV Exposure: ASTM D4587 (UVA-340 bulbs, Cycle 4: 8 hours UV/4 hours condensation) – No reduction in water repellent performance after 5,000 hours exposure.
 - Water Absorption: ASTM C67 (Applied to Ohio Sandstone) - No less than a 96% reduction in water absorption as compared to untreated samples following 24 hours of immersion.
 - Water Absorption: ASTM C97 (Applied to Fire Clay Brick) - No less than a

93% reduction in water absorption as compared to untreated samples following 24 hours of immersion.

- Water Absorption: ASTM C140 (Applied to Cast Mortar Cubes) - No less than a 96% reduction in water absorption as compared to untreated samples following 24 hours of immersion.

NN. Series 700 Hydroflon – Advanced Thermoset Solution Fluoropolymer:

- Exterior Exposure: ASTM D1014 (AAMA 2604-98) (South Florida Marine Exposure) - exceeds the exterior weathering requirements of the American Architectural Manufacturers Association (AAMA) 2604-98 standard.
- Exterior Exposure: ASTM D4141, Method C (EMMAQUA) - No blistering, cracking or chalking. No less than 100% gloss retention, no more than 1 unit gloss loss and no more than 0.23 DEHunter color change (white) after 1,500 MJ/m² (69,109MJ/m² total) EMMAQUA exposure.
- QUV Exposure: ASTM D4587 - No blistering, cracking or chalking. No less than 61% gloss retention (31.4 units gloss change) and 1.89 DEFMC2 (MacAdam units) color change (white) after 25,000 hours exposure.
- Xenon Arc Weathering: ASTM D6695 - No blistering, cracking or chalking. No less than 87% gloss retention (11.9 units gloss change) and no greater than 0.37 DE00 color change (white) after 8,000 hours Xenon Arc exposure.

OO. Series 971 Aerolon – Fluid-Applied Acrylic Insulation Coating:

- Thermal Conductivity: ASTM C518 - Thermal Conductivity shall not be greater than 0.0356 W/m-°K or 0.2468 BTU-in/ft²-hr-°F (R value at one inch equals 4.1).

PP. Series 1026 Enduratone – Acrylic Emulsion:

- VOC Content: 0.38 lbs/gallon (1.4 grams/litre)
- QUV Exposure: ASTM D4587 (UVA-340 bulbs, 8 hours UV, 4 hours condensation) - No blistering, cracking, chalking or delamination of film. No less than 49% gloss retention (2.3 units gloss change) and 0.39 DE00 color change after 10,000 hours exposure.

QQ. Series 1029 Enduratone – HDP Acrylic Polymer:

- Algal Resistance: ASTM D5590 - No more than traces of fungal growth (less than 10%) after three weeks continuous exposure.
- Fungal/Mold/Mildew Resistance: ASTM D5590 - No more than traces of fungal growth (less than 10%) after four weeks continuous exposure.
- QUV Exposure: ASTM D4587 (UVA-340 bulbs, 8 hours UV, 4 hours condensation) - No blistering, cracking or delamination of film. No less than 100% gloss retention, no more than 0.45 DE00 color change and no units gloss loss after 3,000 hours.

RR. Series 1095 Endura-Shield – Aliphatic Acrylic Polyurethane:

- Volatile Organic Compounds (Thinned 15%): 0.80 lbs/gallon (96 grams/litre)
- QUV Exposure: ASTM D4587 (UVA-340 bulbs, 8 hours UV, 4 hours condensation) - No blistering, cracking or delamination. No less than 58% gloss retention or 15.2 units gloss change and 1.40 DECIE2000 color change

(white) after 4,000 hours exposure.

3.27 SYSTEMS REFERENCE GUIDE

A. STEEL & FERROUS METALS

FERROUS METALS - NON-IMMERSION / EXTERIOR / UV-EXPOSED

- 3.14.A.1 System No. 700-1: Zinc/Epoxy/Fluoropolymer
- 3.14.A.2 System No. 1095-1: Zinc/Epoxy/Urethane
- 3.14.A.3 System No. 1095-2: Epoxy/Epoxy/Urethane
- 3.14.A.4 System No. 1095-3: Epoxy Mastic/Urethane (Overcoat)

EXTERIOR – BELOW GRADE

- 3.14.B.1 System No. N140-1: Epoxy/Epoxy/Epoxy or Urethane
- 3.14.B.2 System No. 46H-413-1: Polyamide Epoxy-Coal Tar

INTERIOR (NON-IMMERSION)

- 3.14.C.1 System No. 66-1: Polyamide Epoxy
- 3.14.C.2 System No. 27WB-1: Inorganic Hybrid WB Epoxy (Overcoat)

IMMERSION

- 3.14.D.1 System No. 104-1: Cycloaliphatic Amine Epoxy (Non-Potable)
- 3.14.D.2 System No. 142-1: Flake / Aluminum Oxide Epoxy (Non-Potable)
- 3.14.D.3 System No. 446-1: Aromatic Polyurethane (Non-Potable)
- 3.14.D.4 System No. 142-2: Methanol
- 3.14.D.5 System No. 365-1: Sulfuric Acid
- 3.14.D.6 System No. 22-1: Modified Polyamine Epoxy (Potable)
- 3.14.D.7 System No. 20-1: Polyamide Epoxy (Potable)

B. OVERHEAD METAL DECKING, JOIST

- 3.15.A System No. 115-1: Self-crosslinking Hydrophobic Acrylic (Interior)
- 3.15.B System No. 1029-1 HDP Acrylic Polymer (Exterior)

C. GALVANIZED STEEL & NONFERROUS METALS

GALVANIZED STEEL, STAINLESS STEEL, ALUMINUM, OR COPPER

- 3.16.A System No. 1095-4: Epoxy/High Build Urethane

ALUMINUM IN CONTACT WITH CONCRETE

- 3.16.B System No. 46H-413-2: Polyamide Epoxy-Coal Tar

D. CONCRETE & MASONRY

EXTERIOR-ABOVE GRADE (VERTICAL SURFACES)

- 3.17.A.1 System No. 156-1: Modified Waterborne Acrylate (Elastomeric)
- 3.17.A.2 System No. 1026-1: Acrylic Emulsion (Non-Elastomeric)
- 3.17.A.3 System No. 662-1: Clear Silane/Siloxane Sealer (Min. 42% Solids)
- 3.17.A.4 System No. 626-1: Clear Water Repellent and Graffiti Protectant

EXTERIOR-BELOW GRADE

- 3.17.B.1 System No. 46H-413-3: Polyamide Epoxy-Coal Tar

INTERIOR (NON-IMMERSION)

- 3.17.C.1 System No. 104-2: Cycloaliphatic Amine Epoxy
- 3.17.C.2 System No. 66-2: Polyamide Epoxy
- 3.17.C.3 System No. 113-1: Acrylic Epoxy
- 3.17.C.4 System No. 1026-2: Acrylic Emulsion

IMMERSION

- 3.17.D.1 System No. 104-3: Cycloaliphatic Amine Epoxy (Non-Potable)
- 3.17.D.2 System No. 142-3: Flake / Aluminum Oxide Epoxy (Non-Potable)
- 3.17.D.3 System No. 22-2: Modified Polyamine Epoxy (Potable Water)
- 3.17.D.4 System No. 20-2: Polyamide Epoxy (Potable)
- 3.17.D.5 System No. 262-1: Modified Polyurethane (Non-Potable Repairs)
- 3.17.D.6 System No. 264-1: Modified Polyurethane (Potable Repairs)

E. CONCRETE FLOORS (RESINOUS FLOORING SYSTEMS)

- 3.18.A.1 System No. 248-1: Moisture Cured Urethane (Thin film with increased chemical resistance, UV stability, and durability)
- 3.18.A.2 System No. 222-1: Decorative / Functional Flooring (Non-Slip)
- 3.18.A.3 System No. 287-1: Waterborne Epoxy-Amine Adduct (Thin-film)

F. GYPSUM WALLBOARD & WOOD

GYPSUM WALLBOARD

- 3.19.A.1 System No. N69-1: Polyamidoamine Epoxy
- 3.19.A.2 System No. 113-2: Acrylic Epoxy
- 3.19.A.3 System No. 1026-3: Acrylic Emulsion

WOOD – EXTERIOR or INTERIOR EXPOSURE

- 3.19.B.1 System No. 1029-2: HDP Acrylic Polymer

G. HIGH TEMPERATURE COATINGS

- 3.20.A System No. 1552-1: Acrylic Silicone Copolymer (500°F Max)
- 3.20.B System No. 1556-1: Modified Silicone Copolymer (1000°F Max)
- 3.20.C System No. 1528-1: Silicone Aluminum (1200°F Max)

H. SURFACES EXPOSED TO H₂S/H₂SO₄ (SEVERE EXPOSURE/IMMERSION)

CEMENTITIOUS SURFACES

- 3.21.A.1 System No. 434-1: Modified Aliphatic Amine Epoxy Mortar
- 3.21.A.2 System No. 436-1: Fiber-Reinforced Modified Polyamine Epoxy

FERROUS METAL SURFACES

- 3.21.B.1 System No. 435-1: Modified Polyamine Epoxy
- 3.21.B.2 System No. 431-1: Modified Polyamine Ceramic Epoxy

I. EXTERIOR OF PRESTRESSED CONCRETE TANKS

- 3.22.A System 156-2: New Tanks
- 3.22.B System 156-3: Existing Tanks (Previously Painted)

J. SECONDARY CONTAINMENT AREAS

- 3.23.A System No. 239SC-1: Modified Novolac Epoxy
- 3.23.B System No. 61-1: Cycloaliphatic Amine Epoxy

K. PIPE EXTERIOR COATING SYSTEMS

- 3.24.A System No. 700-2: Zinc/Epoxy/Fluoropolymer (New Aerials)
- 3.24.B System No. N140-2: Epoxy/Epoxy/Topcoat (Buried or Exposed)
- 3.24.C System No. 46H-413-4: Polyamide Epoxy-Coal Tar (Buried Only)
- 3.24.D System No. 1095-5: Acrylic Polyurethane (PVC or HDPE Pipe)
- 3.24.E System No. 1026-4: Acrylic Emulsion (Interior Insulated Pipe)
- 3.24.F System No. 700-3: Epoxy Mastic/Fluoropolymer (Overcoat)
- 3.24.G System No. 1095-6: Epoxy Mastic/Urethane (Overcoat)

L. INSULATIVE COATINGS – THERMAL RESISTANCE

SUBSTRATES UP TO 325°F

- 3.25.A.1 System No. 971-1: Personnel Protection (up to 325°F)

SUBSTRATES BELOW AMBIENT TEMPERATURE

- 3.25.B.1 System No. 971-2: Condensation Control (Sweating)
- 3.25.B.2 System No. 971-3: Condensation Control (Freezing/Icing)

3.28 COATING SCHEDULE

1. Masonry Walls at Electrical Room - System 662-1 (Vertical Surfaces).
2. Aluminum – System 46H-413-2 (In contact with Masonry or Concrete).
3. Concrete Walls and Base Slab - System No. 46H-413-3: Polyamide Epoxy-Coal Tar (Inside face of Plenum walls and base slab)
4. Concrete Floors – System 248-1 (Top Surfaces),

END OF SECTION

SECTION 26 00 00 ELECTRICAL BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish all labor, materials, equipment and incidentals required for a complete electrical installation for the NE WRF MCC-1, DC-1 & DC-2 Replacement Project as required under this Contract as hereinafter specified and/or shown in the Contract Documents.
- B. The purpose of the Division – 26 Specifications and Contract Documents is to provide the Owner with complete and fully functional electrical and control systems that are suitable in every way for the service and design intent. All material and all work which may be reasonably implied as being incidental to the work of the Division – 26 Specifications and Contract Documents shall be furnished by the Contractor at no extra cost to the Owner.
- C. Contractor shall read and examine all Contract Documents thoroughly along with evaluating the Project Site to gain a complete understanding of the Electrical Scope Of Work.
- D. Electrical Scope Of Work, apparatus and materials which shall be furnished under these Division – 26 Specifications and Contract Documents and shall include all items listed hereinafter and/or shown on the Contract Documents.
- E. Contractor shall coordinate and sequence the Electrical Scope Of Work as not to cause shutdown of operations and/or critical processes and abide by those requirements per the Contract Specifications.
- F. Contractor shall employ the services of a third-party NETA testing firm to inspect and test the installation of the 5kV/480V transformers, switchgear, switchboards and cables.
 - 1. Inspection and Testing shall be performed per NETA Standards for Transformers, Switchgear, Switchboards and Cabling. Refer also to:
 - a. NETA STANDARD FOR ACCEPTANCE TESTING SPECIFICATIONS for Electrical Power Equipment and Systems
 - b. 26 00 10 – TESTING AND COMMISSIONING OF ELECTRICAL SYSTEMS
 - 2. Main and tie breakers shall be tested at their setting per:
 - a. 26 00 05 - SHORT-CIRCUIT COORDINATION AND ARC-FLASH ANALYSIS
 - 3. Provide written report of findings with any recommendations and submit to ENGINEER per Section 1.04 of this specification.

- G. Electrical Scope of Work shall include but not limited to the following:
1. Temporary Electrical Power Systems and Equipment as required during construction.
 2. Electrical Demolition
 - a. Removal of existing Low-Voltage Distribution Equipment, conductors and raceway systems.
 3. Modifications along with the installation of New Switchgear Sections to the existing Medium-Voltage Switchgear.
 4. Installation of New Switchgear Sections, New MCC Sections and New Switchboard Sections
 - a. Reference Specification Section:
 - 2) 26 24 13 SWITCHBOARDS
 5. New Raceway Systems as required for low-voltage conductors, cabling and wires for power, control and data circuitries.
 - a. Reference Specification Sections:
 - 1) 26 05 26 – GROUNDING AND BONDING
 - 2) 26 05 43 – UNDERGROUND DUCT-BANKS FOR ELECTRICAL SYSTEMS
 6. New Low-Voltage Distribution Equipment along with Low-Voltage feeders and branch circuits to include all required disconnects, pull-boxes, junction-boxes, terminal-boxes, conduit bodies, raceways, conductors, cabling and wires for power, control and data circuitries.
 - a. Reference Specification Sections:
 - 1) 26 05 19 – LOW-VOLTAGE CONDUCTORS AND CABLES
 - 2) 26 24 16 – PANELBOARDS
 7. New Exterior Lighting System to include fixtures, control devices mountings, structural foundations and all required appurtenances.
 8. New Concrete foundations and/or structural elements to include but not limited to house-keeping pads, equipment rack anchorage, etc. to securely mount and install Electrical Equipment and Systems. These concrete foundations and/or structural element designs shall be prepared by a Florida licensed professional engineer for Engineer review prior to installation.

- a. Reference Specification Sections:
 - 1) DIVISION 03 – CONCRETE
- H. Provide complete and functioning systems in compliance with manufacturer's instructions, performance requirements specified or shown on the Contract Documents and modifications resulting from reviewed and approved submittals and field coordinated drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this section, the requirements of Division – 26 and those Project Documents referenced herein shall be applied.
- B. Related Specification Sections include but not limited to:
 - 1. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS
 - 2. Division 01 – GENERAL CONDITIONS

1.03 REFERENCES

- A. Codes and Standards:
 - 1. American Iron and Steel Institute (AISI):
 - 2. American National Standards Institute (ANSI):
 - a. C2, National Electrical Safety Code.
 - 3. American Society for Testing and Materials (ASTM):
 - 4. Factory Mutual System (FM):
 - a. A Guide to equipment, Materials and Services.
 - 5. Institute of Electrical and Electronics Engineers (IEEE):
 - a. 141, Recommended Practice for Electrical Power Distribution for Industrial Plants
 - b. 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems
 - c. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 6. National Electrical Contractors Association (NECA):
 - a. NECA 1, Good Workmanship in Electrical Construction
 - b. NECA 200, Recommended Practice for Installing and Maintaining Temporary Electrical Power at Construction Sites
 - c. All Project applicable NECA standards and recommendations

7. National Electrical Installation Standards (NEIS):
 - a. Project applicable standards and recommendations
 8. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000V Maximum)
 - b. ICS 6, Enclosures for Industrial Control and Systems
 9. National Electrical Testing Association (NETA)
 - a. STANDARD FOR ACCEPTANCE TESTING SPECIFICATIONS for Electrical Power Equipment and Systems
 10. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC)
 - b. 70E, Standard for Electric Safety in the Workplace
 - c. 79, Electrical Standard for Industrial Machinery
 - d. 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities
 11. Underwriters Laboratories, Inc (UL):
 - a. 96A, Installation Requirements for Lightning Protection Systems
 - b. 508, Industrial Control Equipment
 - c. 508A, Industrial Control
 - d. 698, Industrial Control Equipment for Use in Hazardous Locations
- B. When a specific code or standard has not been cited, the applicable codes and standards of the following code making authorities and standards organizations shall apply:
1. American Association of State Highway and Transportation Officials (AASHTO).
 2. American Iron and Steel Institute (AISI)
 3. American National Standard Institute (ANSI)
 4. American Society for Testing and Materials (ASTM)
 5. ETL Testing Laboratories, Inc (ETL)
 6. Insulated Cable Engineers Association (ICEA)
 7. Institute of Electrical and Electronic Engineers (IEEE)
 8. Illuminating Engineering Society of North America (IES)
 9. Instrument Society of America (ISA)
 10. Lightning Protection Institute (LPI)
 11. National Electrical Manufacturers Association (NEMA)
 12. National Electrical Testing Association (NETA)
 13. National Fire Protection Association (NFPA)
 14. Occupational, Health and Safety Administration (OSHA)
 15. Underwriters Laboratories Inc (UL)

- C. In case of conflict or disagreement between codes, standards, laws, ordinances, rules, regulations, drawings and specifications, or within either document itself, the more stringent condition shall govern.
- D. ENVIRONMENTAL CONDITIONS
 - 1. Outdoor locations may contain wet and corrosive areas:
 - a. Corrosive areas are identified on the Contract Documents. Areas not identified as such shall be considered wet.
 - 2. Indoor locations may contain unclassified, damp, wet and corrosive areas:
 - a. Damp, wet and corrosive areas are identified on the Contract Documents. Areas not identified as such, but provided with heating shall be considered unclassified. Areas not identified as such, but provided without heating shall be considered damp.
- E. DEFINITIONS
 - 1. Outdoor Areas:
 - a. Those locations on the Project site where the equipment is normally exposed to wind, dust, rain, snow, etc. Outdoor areas include areas protected by a roof or rain/sun shields but not enclosed within a structure.
 - 2. Indoor Areas:
 - a. Those locations on the Project site where the equipment is normally protected from wind, dust, rain, snow, etc.
 - 3. Hazardous Areas:
 - a. Those areas where explosive gases, dusts or liquids can accumulate creating an explosive atmosphere.
 - 4. Corrosive Areas:
 - a. Those areas where gases, liquids or solids can cause a corrosive environment for metals, concrete and plastics.

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division – 26 Sections as required per the Contract Specifications.
- B. All Submittal packages shall include a complete copy of the applicable Specification Sections. Contractor shall review and indicate that all items within the submittal are compliant with the Specifications by indicating with a 'check mark' by each paragraph. Any items that do not meet the requirements, Contractor shall indicate by marking the corresponding paragraph with an 'x'. Those items not in compliance with the Specifications, a written clarification shall be provided by the

Contractor describing how the submittal differs from the requirements outlined in the Specification Sections and a detailed explanation why it is not possible to meet those requirements. Any submittal package received without marked-up Specification Sections shall be rejected and returned by the Engineer without review.

C. Shop Drawings:

1. Shop drawings shall be arranged and labeled according to specification section and Contract Drawing.
2. Submit shop drawings prior to purchase or fabrication of equipment. See individual Division – 26 Sections for additional specific requirements.
3. Prior to submittals of shop drawings, coordinate electrical equipment, particularly motor control equipment, control panels, and instrumentation, with all applicable equipment and systems interfacing with that equipment.
4. Submittals shall be made in the following combinations:
 - a. Medium-Voltage Electrical Equipment ($1\text{kV} \leq 35\text{kV}$)
 - 1) Load Interrupters, Switchgear, Unit Sub-Stations, Transformers.
 - 2) Motor Control Centers
 - 3) Circuit Protection Devices, Fuses, Cut-Outs, etc.
 - b. Low Voltage Electrical Equipment ($\leq 600\text{V}$)
 - 1) Panelboards, Load Centers, (lighting panels), Disconnect Switches, Transformers.
 - 2) Motor Control Centers.
 - c. Raceway Systems
 - 1) Conduits, Cable Trays, Duct-Bank details, Manholes, Handholes, Pull-Boxes, Junction Boxes, Conduit Bodies and Fittings.
 - 2) Conduit layout drawings for major and/or complex routings.
 - 3) Cable-Tray layout dimensional drawings with complete Bill Of Materials (BOM).
 - d. Medium-Voltage Cables and Conductors ($1\text{kV} \leq 35\text{kV}$)
 - 1) Cables and conductors
 - 2) Terminations and Splicing
 - e. Low-Voltage Wire and Cables ($\leq 600\text{V}$)
 - 1) Feeder Circuitry power cables and conductors
 - 2) Branch Circuitry cables and conductors

- 3) Control/Signal Circuitry
 - 4) Low Voltage Systems: Tele/Com, Data, Security, Video
- f. Wiring Devices
 - 1) Receptacles, Switches
 - g. Lighting
 - 1) Interior/Exterior Lighting Fixtures, Site Lighting Fixtures
 - h. Supports and Hardware
 - 1) Strut-Channel, Equipment Racks and Stanchions, Fasteners, Concrete Bases, Anchorage, etc.
 - a) Installation Detail Sketches, Layouts, BOM
 - i. Electrical Systems Raceway Schedule
 - 1) Provide an Electrical Systems Raceway Schedule for Engineer review, reference:
 - j. Electrical Systems Raceway Schedule
 - 1) Provide an Electrical Systems Raceway Schedule for Engineer review, reference:
 - a) Specification Section 26 00 15 Identification for Electrical Systems
5. For each product, clearly identify manufacturer by name. When general data sheets are provided as part of the submittal, specifically identify the products to be used on this Project. Provide manufacturer's technical information on products to be used, including:
- a. Product descriptive bulletin.
 - b. Electrical data pertinent to the Project and necessary to assure compliance with Specifications and Contract Documents.
 - c. Equipment dimensions, where applicable.
 - d. Evidence that the products submitted meet the requirements of the standards referenced.
 - e. Specify part number with explanation of options selected.
6. Ensure that all submittals clearly indicate the equipment is UL or ETL listed.
7. For all equipment, provide manufacturer's installation instructions.
- D. When a quality standard has been established by identification of a specific manufacturer or catalog number, submittals for proposed alternates and substitutions shall include:

1. Alternate and substitute equipment cross referenced to the equipment it is replacing. Submittal shall be marked to show how differences will be accommodated.
2. Calculations and other detail data to allow determination of alternate and substitute equipment equivalency to the equipment it is replacing. Data supplied shall allow detailed comparison of all significant characteristics upon which the design equipment is based.
3. Dimensioned drawings, of the same or larger scale as the Contract Documents, for all alternate and substitute equipment, which differs in size, configuration, service accessibility or in any significant way from the equipment it is replacing.
 - a. Complete system layout, except that portion which is identical to the Contract Documents.
 - b. Redesign and modifications to all work required by the alternate or substitute equipment.

E. Operation and Maintenance Manuals.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Contractor shall unload and handle materials using methods, rigging, and equipment that will prevent damage to the materials. Care shall be used to prevent damage to painted and galvanized surfaces.
 1. Bare wire rope slings shall not be used for unloading and handling materials and equipment, except with the specific written permission of the Engineer.
- B. Equipment and materials, in accordance with the manufacturer's recommendations, shall be stored, supported and protected to prevent damage.
 1. Stored materials and equipment shall not be allowed to contact the ground.
 2. Equipment and materials which incorporate electrical equipment or which have finished painted surfaces, and other items which would be damaged by outdoor exposure, shall be stored indoors.
 - a. Provide covering and shielding for all equipment to protect from damage.
 - b. When such storage would present an unreasonable building space or volume requirement, the equipment or materials may, when acceptable to the Engineer, be stored under weatherproof coverings on shoring or platforms.
 3. All small loose items that could be easily lost, stolen, broken, or misused shall not be stored on open platforms or shoring.
 4. All storage methods and schedules shall be acceptable to the Engineer.

- C. Ensure that equipment is not used as steps, ladders, scaffolds, platforms, or for storage either inside or on top of enclosures.
- D. Protect nameplates on electrical equipment to prevent defacing.
- E. Repair, restore or replace damaged, corroded and rejected items at no additional cost to the Owner.
- F. Record Drawings:
 - 1. Contractor shall maintain a marked up set of Document Drawings showing actual installed circuit numbers, conduit sizes, cable tray routing, number of conductors, conductor sizes (other than 12AWG) and all other deviations from the design drawings.
 - 2. All underground conduit and concealed items shall be dimensioned on the Document Drawings from permanent, visible, building features.
 - 3. Provide actual motor size, starter size, and heater size, along with all other protective equipment for all motor circuits as part of the one-line record drawings.
 - 4. Revise all wire/cable identification schedules to indicate as installed conditions.
 - 5. Revise all panelboard schedules to indicate as installed conditions.

1.06 OPERATION AND MAINTENANCE MANUALS - NOT USED

1.07 WARRANTY - NOT USED

1.08 IDENTIFICATION

- A. Contractor shall reference and provide all identification, tagging and labeling for electrical and control systems as required per Specification Section:
 - 1. 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Refer to related Division 26 Sections. All equipment of a similar type shall be by one manufacturer unless otherwise noted in the Specifications.
- B. Subject to compliance with the Contract Documents all electrical equipment and materials shall be acceptable as specified in the Owner's Approved Products List

2.02 MATERIALS

- A. Trade names and catalog numbers may be used in the Contract Documents or Specifications to establish quality standards and basics of design.
 - 1. Other listed manufacturers in the applicable specification sections with equal equipment may be acceptable.
 - 2. If no other manufacturer is listed then any manufacturer of equal equipment may be acceptable.

- B. Listed: Where UL test procedures have been established for the product type, electrical equipment shall be approved by UL or ETL and shall be provided with the UL or ETL label.

2.03 FABRICATION

- A. When equipment is shop fabricated for the Project, the electrical devices and enclosures utilized shall be UL or ETL listed and labeled or shall be UL recognized.
 - 1. Contractor shall submit for Engineer review all fabricated electrical and control equipment assemblies, enclosures including but not limited to: equipment racks or support systems.
- B. Shop or Factory Finishes: Interiors of other painted equipment shall be white.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Equipment shall be installed in accordance with the requirements of the NEC.
- B. Enclosures for use with electrical equipment unless specifically shown or specified elsewhere in the Contract Documents:
 - 1. NEMA 1G/12 dry Interior Areas:
 - a. Acceptable for use in the Electrical Building or those interior spaces that are provided with temperature and humidity controlled conditioned air.
 - 2. NEMA 4X Wet / Corrosive Areas:
 - a. Acceptable for use in all exterior and interior areas or spaces.
 - b. Enclosures shall be 316-Stainless-Steel
 - c. Exposed Junction or Pull Boxes /Non-Chlorine Areas shall be Aluminum. minimum.316-Stainless in Chlorine Areas.
 - c. Nonmetallic enclosures are not acceptable.
 - 3. NEMA 7 Hazardous Areas:
 - a. Explosion proof for classified areas deemed Class 1 Division 1 and Division 2.
 - b. Acceptable for use in all exterior and interior areas or spaces.
 - 4. Exceptions:
 - a. As required in other Division 26 Sections.
 - b. As otherwise indicated in the Contract Documents.
- C. Coordinate the installation of electrical equipment with other trades.
 - 1. Arrange for the building in of equipment during structure construction.

2. Where equipment cannot be built in during construction, arrange for sleeves, box outs, openings, etc., as required to allow installation of equipment after structure construction is complete.
- D. Verify that equipment will fit support layouts indicated.
- E. Equipment Dimensions and Clearances:
1. Equipment shall fit in the locations shown in the Contract Documents.
 2. Do not use equipment or arrangements of equipment that reduce required clearances or exceed the space allocation.
- F. Install equipment in accordance with the manufacturer's instructions.
- G. Equipment Access:
1. Install equipment so it is readily accessible for operation and maintenance.
 2. Equipment shall not be blocked or concealed.
 3. Do not install electrical equipment such that it interferes with normal maintenance requirements of other equipment.
- H. Equipment shall be installed plumbed, square and true with the building construction and shall be securely fastened.
- I. Outdoor wall mounted equipment and indoor equipment mounted on earth or water bearing walls shall be provided with corrosion resistant spacers to maintain 1/4IN separation between the equipment and the wall.
- J. Screen or seal all openings into outdoor equipment to prevent the entrance of rodents and insects.
- K. Equipment fabricated from aluminum shall not be placed in direct contact with earth or concrete.
- L. Provide for concrete curbs under all equipment and slab penetrations under wall mount equipment. Curb height to be minimum 3-inches under wall mounted and 4-inches under equipment.
- M. Provide all necessary anchoring devices and supports.
1. Reference Specification Section 26 05 29 – ELECTRICAL HANGERS AND SUPPORTS
 2. Use supports as detailed in the Contract Documents and as specified.
 3. Where not detailed on the Contract Documents or specified, use supports and anchoring devices rated for the equipment load and as recommended by the manufacturer.
- N. Contractor shall verify exact rough in locations and dimensions for connection to electrical items to be installed under this Contract.
1. Shop drawings shall be secured from those furnishing the equipment.

2. Proceeding without proper information may require the Contractor to remove and replace work that does not meet the conditions imposed by the equipment supplied.
3. Provide sleeves wherever openings are required through new concrete or masonry members. Place sleeves accurately and coordinate locations with the Engineer.
4. Should any cutting and patching be required on account of failure of the Contractor to coordinate penetrations, such cutting and patching shall be done at the expense of the Contractor.
 - a. Contractor shall not endanger the stability of any structural member by cutting, digging, chasing, or drilling and shall not, at any time, cut or alter the work without the Engineer's written consent.
 - 1) Provide additional reinforcing if required.
 - 2) Cutting shall be done neatly using proper tools and methods.
 - b. Subsequent patching to restore walls, ceilings, or floors to their original condition shall be done by workmen skilled in their particular field.
- O. Provide concrete foundations or pads required for electrical equipment as indicated or specified.
 1. Floor mounted equipment shall be mounted on a 4IN high concrete housekeeping pad. Pad shall be poured on top of the finished floor or slab.
- P. Material that may cause rusting or streaking on a building surface shall not be used.
- Q. Contractor shall coordinate the installation of the conduit and wire associated with the HVAC equipment supplied under this Contract.

3.02 FIELD QUALITY CONTROL

- A. Contractor shall reference and provide all testing procedures, reports and data for Engineer review and approval for electrical systems as required per Specification Section:
 1. 26 00 10 – TESTING AND COMMISSIONING OF ELECTRICAL SYSTEMS
- B. Verify all components are operational.
- C. Perform ground fault performance testing as required by NEC Article 230 95(c).
- D. Test Equipment Interface:
- E. Verify systems coordination and operation.

1. Set all adjustable trip protective devices as required for system protection and coordination.
- F. Verify all system and equipment ground continuity.
- G. Adjust installed equipment for proper operation of all electrical and mechanical components.
- H. Replace equipment and systems found inoperative or defective and re test.
1. If equipment or system fails re test, replace it with products that conform to Contract Documents.
 2. Continue remedial measures and re tests until satisfactory results are obtained.
 3. Remedial measures and re tests will be done at no cost to the Owner.
- I. The Engineer shall be notified of tests and Engineer may witness individual tests at their discretion.
- J. Required certificates of testing and test reports shall be presented to the Engineer upon completion of the tests.
- K. At Completion of Installation:
1. Test to ensure all equipment is free of short circuits and improper grounds.
 2. Test to ensure all equipment is operational.
- L. After installation, all equipment shall be tested as recommended by the manufacturer.

3.03 STRUCTURAL COORDINATION

- A. Contractor shall reference all structural and building requirements prior to installing work and shall not interfere with any structural foundation component such as footings, bearing walls, etc. Contractor shall identify any structural interference and notify the Engineer immediately prior to continuation of work.
- B. Do not remove or damage fireproofing materials.
1. Install hangers, inserts, supports, and anchors prior to installation of fireproofing.
 2. Repair or replace fireproofing removed or damaged.
- C. Make all penetrations through roofs prior to installation of roofing.
- D. All penetrations required after installation of roofing, shall be completed by an authorized roofer to maintain the roof warranty.
- E. Make all penetrations of electrical work through walls water and weather tight.

- F. Equipment furnished under this Contract for use on future work and all concealed equipment, including conduits, shall be dimensioned, on the Record Drawings, from visible and permanent building features.

3.04 PROJECT CLOSEOUT

- A. Cleaning
 - 1. Clean dirt and debris from all interior and exterior surfaces.
 - 2. Exterior surfaces shall be cleaned with manufacturer approved cleaning agents.
 - 3. Apply touch up paint as required to repair scratches, etc.
 - 4. Replace nameplates or wire and cable markers damaged during installation.
 - 5. Thoroughly vacuum the interior of all enclosures to remove dirt and debris. Do not use pressurized air systems to blow out dirt and debris.

- B. Demonstration
 - 1. Demonstrate equipment has been installed and operational in accordance with Contract Requirements and Project Specifications.

END OF SECTION

SECTION 26 00 01 – ELECTRICAL DEMOLITION

PART 1 -GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish all labor, materials, equipment and incidentals required for the removal of existing electrical equipment, wiring, raceways, etc. in those areas to be remodeled or refurbished; removal of designated construction; dismantling, cutting and alterations to complete the Electrical Scope of Work as required under this Contract as hereinafter specified and/or shown in the Contract Documents.
 - 1. Disposal of materials.
 - 2. Storage of removed materials.
 - 3. Identification of utilities.
 - 4. Protection of items to remain as shown on the Contract Documents.
 - 5. Relocate existing electrical equipment to accommodate construction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this section, the requirements of Division 26 and those Project Documents referenced herein shall be applied.
- B. Related Specification Section(s) include but not limited to
 - 1. Division 01 – GENERAL CONDITIONS

1.03 REFERENCES

- A. Codes and Standards
 - 1. Environmental Protection Agency (EPA)
 - a. 40 CFR Part 761, Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions.
 - b. 40 CFR Part 273, Standards for Universal Waste Management.
 - 2. National Fire Protection Association (NFPA)
 - a. 70, National Electrical Code
 - b. 70E, Standard for Electric Safety in the Workplace
 - 3. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA)

- a. 29 CFR Part 1910.94 Subpart G, Occupational Health and Environmental Control.
- 4. U.S. Department of Transportation (USDOT)
 - a. 49 CFR Part 178, Regulations for Shipping Container Specifications.

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per the Contract Specifications.
- B. Submit the following in accordance with Project submittal procedures:
 - 1. Project Record Documents: Record actual locations of capped [utilities] [conduits and equipment abandoned in place.
- C. Existing Conditions
 - 1. Contractor shall coordinate and sequence electrical demolition so as not to cause shutdown of operations, process and comply with those as requirements per the Contract Specifications.
 - a. 26 00 00 – ELECTRICAL BASIC REQUIREMENTS
 - 2. The electrical demolition shall minimize interference with adjacent structures, buildings and operable process areas.
- D. Shut-Down Periods
 - 1. Contractor shall arrange timing of electrical shut-down periods with the Owner and/or designated representative. Contractor shall not shut down any utility without prior written approval.
 - 2. Contractor shall keep shut-down period to minimum or use intermittent periods as directed by the Owner.
 - 3. Contractor shall maintain life-safety systems in full operation in occupied facilities, or provide notice minimum three days (3DY) in advance.
 - 4. Identify salvage items in cooperation with the Owner.
- E. Qualifications
 - 1. Contractor personnel performing electrical demolition shall be a qualified person as defined by NFPA 70E and the NEC.
 - 2. All demolition work shall conform to requirements of the National Electrical Code (NEC), OSHA, NFPA 70E – Standard for Electrical Safety in the Workplace, and Owner Safety Programs.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Reference those applicable Specification Sections

1.06 OPERATION AND MAINTENANCE MANUALS

- A. Reference those applicable Specification Sections

1.07 WARRANTY

- A. Reference those applicable Specification Sections

1.08 IDENTIFICATION

- A. Contractor shall reference and provide all identification, tagging and labeling for electrical and control systems as required per Specification Section(s)

1. 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 2 -PRODUCTS – NOT USED

PART 3 -EXECUTION

3.01 COORDINATION

- A. Contractor shall coordinate with all trades, subcontractors, vendor representatives, with Engineer, Engineer's Representative and/or Owner prior to executing Demolition Plan(s).

3.02 EXAMINATION

- A. Prior to commencing work on the demolition or salvage of electrical equipment, wiring, or systems:

1. Contractor shall inspect the Project Site to identify any hazardous materials such as PCBs, asbestos, lead, mercury or other heavy metal, or toxic, flammable or explosive materials, or radioactive materials that may be handled, disturbed or removed. Typical locations of hazardous materials include but not limited to the following:

- a. Lead: Batteries in emergency luminaires, exit signs, fire alarm panels, security systems, UPS systems, and some switchgear. Lightning protection components on some exhaust stacks.
- b. PCBs: Oil-filled transformers; potting material and/or capacitors in lighting ballasts; oil-filled capacitors associated with motors, UPS systems, voltage regulators, power-factor correction equipment.
- c. Asbestos: Pipe insulation, electrical insulation
- d. Mercury: Fluorescent lamps, HID lamps, thermostats, silent wall switches, some silent enclosed relays
- e. Radioactive materials: Self-luminous exit signs, smoke detectors.

2. Contractor shall verify whether or not PCB ballasts exist in light fixtures which will be removed or relocated.
 - a. If PCB light fixture ballasts exist, then follow the requirements in Section 3.5 - PCB BALLAST HANDLING AND DISPOSAL.
 3. Contractor shall have the inspection results available at the Project Site, including any drawings, plans or specifications, as appropriate, to show the locations of any hazardous substances.
 4. Contractor shall ensure that any hazardous materials found are safely contained or removed.
 5. During demolition work, if hazardous materials are discovered that were not identified in the initial inspection required above, Contractor shall stop work in the area and immediately notify the Owner and/or Engineer. Contractor shall not resume work in the area until directed by the Owner and/or Engineer.
- B. Contractor shall verify wiring and equipment indicated to be demolished serve only abandoned facilities.
- C. Contractor shall verify termination points and lock-out tag-out device locations for services, circuits, and systems to be disconnected or removed.
- D. Demolition Drawings are based on casual field observation and/or existing record documents. Report discrepancies to the Owner and/or Engineer before beginning demolition work.
- E. Beginning of demolition work will constitute the Contractor has accepted existing conditions.

3.03 PREPARATION

- A. Contractor shall protect existing materials, appurtenances and equipment which are not to be demolished. Contractor shall repair or replace existing materials, appurtenances and equipment, building exterior and interior, and landscaping altered or damaged during demolition work to match existing undisturbed conditions at no additional cost to Owner.
- B. Contractor shall erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures for protection of the public, Owner personnel and Contractor employees.
- C. Contractor shall provide temporary egress signage and emergency lighting to meet Life Safety Code requirements.
- D. Contractor shall provide and maintain temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and

installation of new construction to ensure that no water leakage or damage, or wind damage occurs to structure or interior areas of existing building.

- E. Contractor shall use debris chute(s) and covered debris bins to remove and temporarily store waste materials. The location of debris chute(s) and bins shall be approved by the Owner.
- F. Contractor shall maintain parking areas, driveways, exterior walkways, exit paths, and landscaping in a clean, undisturbed condition.
- G. Contractor shall coordinate utility service outages with the Owner.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
 - 2. Protect utilities indicated to remain, from damage.
- H. Provide temporary wiring and connections to maintain existing systems in service during construction. In particular, security systems, safety class systems, safety significant systems, and life safety systems must be maintained in operation at all times. This includes security and safety lighting.
- I. Existing Medium-Voltage Electrical Systems
 - 1. Protect existing medium-voltage equipment, transformers, switchgear, cables, duct-banks and man-holes. Do not disturb or operate medium-voltage systems or equipment. Coordinate shutdowns or equipment removal with the Owner at least five working days (5DY) before required date.
- J. Existing Low-Voltage Electrical Distribution
 - 1. Maintain existing low-voltage electrical distribution in operation until new work is complete and ready for operation. Disable low-voltage electrical distribution only to make switchovers and connections. Obtain permission from the Owner at least two working days (2DY) before partially or completely disabling low-voltage electrical distribution. Minimize outage durations. If required, make temporary connections to maintain low-voltage electrical distribution in areas adjacent to work area.
- K. Existing Communication/Data Systems
 - 1. Coordinate demolition work with Owner and maintain existing telecommunications system in service until new work is complete and ready for service. Obtain permission from the Owner before removing telecommunications wiring or equipment.
- L. Existing PLC / SCADA Systems

1. Maintain existing PLC/SCADA systems in operation until new work is complete and ready for operation. Disable PLC/SCADA systems only to install new programming, equipment, components, wiring, etc. Obtain permission from the Owner at least five working days (5DY) before partially or completely disabling PLC/SCADA systems. Minimize outage durations.

3.04 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Contractor shall demolish, relocate, and extend existing electrical work to accommodate and install new work to complete the Electrical Scope Of Work.
- B. Contractor shall establish an electrically safe work condition in areas where electrical work is to be removed.
 1. Comply with Owner Safety Program(s).
 2. Comply with Project Lockout/Tagout for Hazardous Energy Control.
 - a. Verify zero-voltage before beginning demolition. Disconnect, remove, and cap designated utility lines within demolition boundary limits. Mark locations of disconnected utilities. Identify utilities and indicate capping locations on Project Record Documents.
- C. Contractor shall protect and retain power to existing active equipment that is to remain.
 1. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
 2. Install temporary wiring and connections to maintain existing systems in service during construction.
- D. Carefully remove equipment, materials, or fixtures which are to be reused. Store and protect to prevent damage.
 1. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.
- E. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final Project.
 1. Remove items in an orderly and careful manner.
 2. Remove abandoned wiring to panelboard circuit breaker or source of supply.
 3. Remove exposed abandoned raceways, including abandoned raceways above accessible ceiling finishes. Cut raceways flush with walls and floors, seal openings, and patch surfaces.
 4. For abandon conduits or existing conduits converted to spares.

- a. Pull raceway wire brush sized for raceway and draw within to remove larger debris.
 - b. Swab raceway by pulling a clean, tight fitting rag through the raceway as many times as required to remove smaller debris, dirt, sand, mud, etc.
 - c. Pull mandrel with diameter nominally 1/4IN smaller than the internal diameter of the raceway, to ensure circular cross-section and removal of any obstructions.
 - d. Cap interior ends of conduit with water tight sealant. Cap exterior ends of conduit with end cap of conduit material.
 - e. Tag conduit as spare or abandoned.
5. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
 6. Remove lamps from abandoned luminaires. Reference requirements in Section 3.6 - LAMP HANDLING AND DISPOSAL.
 7. Disconnect and remove abandoned luminaires. Reference the requirements in Section 3.5 - PCB BALLAST HANDLING AND DISPOSAL. Remove brackets, stems, hangers, and other accessories.
 8. Remove abandoned cable tray systems.
 9. Disconnect and remove abandoned panelboards and distribution equipment.
 10. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
 11. Remove exposed abandoned fasteners and supports, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.
 - 12.
 13. Cap abandoned empty conduit at both ends.
 14. If certain raceways and boxes are abandoned but not scheduled for removal, identify those items on the As Built Drawings.
- F. Provide proper and permanent support to adjacent structure for all raceways, cable trays, luminaires, and equipment to remain.
 - G. Repair adjacent construction and finishes damaged during demolition and extension work.

1. Patch and seal unused existing wall penetrations to match existing conditions and to restore fire rating.
- H. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. This includes the extension of the circuit from the last active device to the next device in the system to be activated.
1. Reconnect equipment being disturbed by renovation work and required for continued service nearest available panel.
- I. Contractor shall investigate and measure the nature and extent of unanticipated items that conflict with intended function or design. Contractor shall submit written report with accurate detailed information to the Owner and/or Engineer. While awaiting instructions from the Owner and/or Engineer, rearrange selective demolition schedule as necessary to continue overall job progress without delay.
- J. Stop work and notify the Owner and/or Engineer immediately if structure or other items to remain appear to be endangered. Do not resume work until directed by the Owner and/or Engineer.
- K. Remove demolished materials as work progresses.

3.05 EXISTING ELECTRICAL DISTRIBUTION EQUIPMENT

- A. Contractor shall verify and identify loads served by circuits in existing electrical distribution equipment (e.g. switchgear, switchboards, motor control centers, panelboards) affected by the Electrical Scope Of Work. Where additional circuits are needed, reuse circuits available for reuse. Contractor shall install new circuit breakers as required.
- B. Tag unused circuits as spare.
- C. Where existing circuits are indicated to be reused, use measuring devices to verify circuits feeding Project area are not in use.
- D. Remove existing wire no longer in use from distribution equipment to equipment.
- E. Re-label circuit breakers, switches, and controllers to indicate loads served. Provide new, updated circuit directories where more than three circuits in a panelboard have been modified or rewired.

3.06 PCB BALLAST HANDLING AND DISPOSAL

- A. General
1. High power factor fluorescent light ballasts manufactured before 1978 and some HID ballasts contain PCB compounds in their capacitors. PCB ballast handling, storage, and disposal shall be in accordance with 40 CFR Part 761 and other applicable EPA PCB regulations.

- B. Contractor shall inspect all ballasts in all light fixtures which will become the property of the Contractor and will be removed from the Project Site as required under this Contract to include the actions described below.
1. All ballasts labeled as "NON-PCBs" or "NO PCBs" shall become the property of the Contractor. If the PCB content is not stated on the ballast label, handle the ballast as a PCB ballast.
 2. Remove PCB ballasts from the light fixtures and cut the wires off. However, before removal, carefully inspect PCB ballasts for leaks. If ballast appears to be leaking (evidenced by potting compound leaking out or by an oily film on the ballast surface) handle the ballast per 40 CFR Part 761 and other applicable EPA PCB regulations. This means the ballast is to be carefully removed from the fixture and placed in an approved drum. The person removing the ballast from the fixture shall wear the appropriate Personal Protection Equipment (PPE) as necessary.
 3. If the fixture has also been contaminated, it will require cleaning to less than 10 micrograms/100 square centimeters contamination before disposal. This cleaning must be done by an approved PCB Subcontractor.
 4. Place the ballasts in US DOT approved type 17C or type 17H drums furnished by the PCB Subcontractor. The quantity and size of the drums will be determined by the Subcontractor at the time of construction.
 5. Place these barrels in storage with the cover that came with the barrels, in a location within a building, as designated by the Owner. Do not place the barrels outside where they are exposed to weather.
 6. The ballasts are not to be removed from the Project Site by the Subcontractor. Doing so, will violate USDOT hazardous waste regulations and may result in a fine to the Contractor.
 7. Label and mark the PCB storage drums with EPA approved PCB labels and the storage area with signs, marks and lines to meet state and federal regulations.
 8. Provide approved PCB absorbent materials to be stored immediately adjacent to the drum storage area. Do not place loose absorbent material in the drums.
 9. Provide the Owner, in written form, a total count of these ballasts (or their total weight by barrel) and where they are stored.
- C. When the ballast demolition is completed, and all PCB ballasts are placed in drums ready to be picked up for disposal, notify the Owner and/or Engineer. Contractor shall make arrangements for pick-up, transport and disposal.

3.07 LAMP HANDLING AND DISPOSAL

A. General

1. Most lamps (fluorescent, incandescent, and HID) contain mercury and/or lead (in the base) as well as other heavy metals and compounds which are regulated by the EPA during the disposal process. The handling, storage, and disposal of lamps shall be in accordance with 40 CFR Part 273.

B. Contractor shall handle lamps which have been removed from service for disposal as follows:

1. Very carefully remove all lamps (fluorescent, incandescent, and HID) from light fixtures before removal of the fixture from its mounted position. This is to reduce the likelihood that the lamp(s) will be broken. If more than 1% of the total lamps removed from the Project are broken, Contractor will be charged the cost difference between disposal of broken lamps and disposal of unbroken lamps for all lamps broken in excess of 1% of the total lamps removed in the Project.
2. Provide containers large enough to fully conceal the removed lamps and appropriate for lamp transportation. Place removed lamps in containers and mark container with the number and type of lamps. Place containers in a location on the Project Site as directed by the Owner. Contractor shall label the area as "Hazardous Material Storage - Mercury".
3. Provide the Owner, in written form, a count of all stored lamps by type at the completion of the project.
4. Contractor shall make arrangements for pick-up, transport and disposal.

3.08 CLEANING AND REPAIR

A. Contractor shall clean and repair existing materials and equipment which remain or are to be reused.

B. Electrical Distribution Equipment

1. Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide approved closure plates for vacant positions.

C. Luminaires

1. Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts (if required) and broken electrical parts. Test for proper operation.

3.09 DISPOSITION OF MATERIAL AND EQUIPMENT

- A. Contractor shall remove and protect those items as indicated on the Contract Documents to be salvaged and deliver in good condition to the location designated by the Owner.
- B. Items of salvageable value may be removed as work progresses. Transport salvaged items from Project Site as they are removed.
- C. Unless indicated otherwise, material(s) removed as required under this Contract which are not to be salvaged or reused shall become the property of the Contractor.
- D. Unless indicated otherwise, immediately remove demolished material from site. Do not store or permit debris to accumulate at the site. Dispose of materials legally off site. Burning or burying materials on the Project Site are prohibited.
- E. Upon completion, clean the entire area of demolition residue satisfactory for the continuation of the Work. Remove temporary work.

3.10 INSTALLATION OF RELOCATED EQUIPMENT

- A. Install relocated materials and equipment under the provisions of the applicable Sections of these Specifications.

3.11 PROJECT CLOSEOUT

- A. Contractor shall provide a compiled report of those materials removed and/or disposed of to include but not limited to: hazardous materials, tonnage, transportation logs, bill of lading, land-fill reports, etc. prior to Project close out.

3.12 ATTACHMENTS

- A. Schedules
 - 1. Existing Equipment / Materials to be removed and disposed
 - 2. Existing Equipment / Materials to be salvaged and surrendered to Owner

END OF SECTION

SECTION 26 00 05 SHORT CIRCUIT COORDINATION & ARC FLASH ANALYSIS

PART 1 – GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish Short-Circuit Coordination Study to include all relay and protective device settings as prepared by the electrical equipment supplier or an approved engineering firm. Areas of the study shall be limited to:
 - 1. The ATS and the Main Switchboard DC-1 feeder breaker.
 - 2. Switchboard DC-2 feeder breaker.
 - 3. MCC-1 along with all the 480V and 208V 3-phase equipment in the FRP Building down to the disconnecting means.
 - 4. The 480V and 208V 3-phase equipment located in the maintenance room down to the disconnecting means.

- B. Contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E - Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E-202104, Annex D.

- C. Scope Of Work for the studies shall include all new distribution equipment supplied by the electrical equipment supplier under this Contract as well as all the applicable existing electrical equipment at the Project site.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this Section, the requirements of Division 26 and those Project Documents referenced herein shall be applied.

1.03 REFERENCES

- A. Codes and Standards latest editions.
 - 1. American National Standards Institute (ANSI):
 - a. C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - b. C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - c. C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

- d. C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
- a. 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - b. 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
 - c. 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - d. 399 – Recommended Practice for Industrial and Commercial Power System Analysis
 - e. 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
 - f. 1584 - Guide for Performing Arc-Flash Hazard Calculations
3. National Fire Protection Association (NFPA)
- a. 70 - National Electrical Code, latest edition
 - b. 70E – Standard for Electrical Safety in the Workplace

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per the Contract Specifications.
- B. Computer Analysis Software
 - 1. The studies shall be performed using the latest version of SKM® Systems software program or approved equal.
- C. Preliminary Submittal For Engineer Review
 - 1. The short-circuit and protective device coordination studies shall be submitted to the Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for production. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.
- D. Final Submittal for Engineer Review
 - 1. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five (5) bound hard copies of the complete final report shall be submitted. Electronic copies of the resultant computer analysis software

study(ies) shall be included and compatible with the latest version of SKM® Systems software.

2. The report shall include the following sections:
 - a. Executive Summary
 - b. Descriptions, purpose, basis and scope of the study
 - c. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties
 - d. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection
 - e. Fault current calculations including a definition of terms and guide for interpretation of the computer printout
 - f. Details of the incident energy and flash protection boundary calculations
 - g. Recommendations for system improvements, where needed
 - h. One-line diagram(s)

E. Qualifications

1. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer in the State of North Carolina skilled in performing and interpreting the power system studies.
2. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm
3. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
4. The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Reference those applicable Specification Section(s)

1.06 OPERATION AND MAINTENANCE MANUALS

- A. Reference those applicable Specification Section(s)

1.07 WARRANTY

- A. Reference those applicable Specification Section(s)

1.08 IDENTIFICATION

- A. Contractor shall reference and provide all identification, tagging and labeling for electrical and control systems as required per Specification Section(s)

1. 26 00 15 – INDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. NOT USED

2.02 STUDIES

- A. Contractor shall furnish short-circuit and protective device coordination studies as prepared by equipment supplier or an approved engineering firm.
- B. Contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E, Article 130.3 and Annex D.

2.03 DATA COLLECTION

- A. Contractor shall furnish all data as required by the power system studies. The engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing. Existing equipment may require the engineer to visit site, of which those costs shall be borne by the Contractor.
- B. Source combination may include present and future motors and generators.
- C. Load data utilized may include existing, new and proposed loads obtained from the Contract Documents, Engineer or Owner.
- D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.04 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.
- B. Transformer design impedances shall be used when test impedances are not available.
- C. Provide the following:
 - 1. Calculation methods and assumptions
 - 2. Selected base per unit quantities
 - 3. One-line diagram of the system being evaluated
 - 4. Source impedance data, including electric utility system and motor fault contribution characteristics
 - 5. Tabulations of calculated quantities

6. Results, conclusions, and recommendations.
- D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
1. Electric utility's supply termination point
 2. Incoming switchgear
 3. Motor control centers
 4. Standby generators
 5. Branch circuit panelboards
 6. Other significant locations throughout the system.
- E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- F. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short circuit ratings
 2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
 3. Notify Engineer in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.

2.05 PROTECTIVE DEVICE COORDINATION STUDY

- A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
 1. Electric utility's overcurrent protective device
 2. Medium voltage equipment overcurrent relays
 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
 6. Conductor damage curves

7. Ground fault protective devices, as applicable
 8. Pertinent motor starting characteristics and motor damage points, where applicable
 9. Pertinent generator short-circuit decrement curve and generator damage point
 10. The largest feeder circuit breaker in each motor control center and applicable panelboard.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.06 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E-2004, Annex D.
- B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, centers and panelboards, busway and splitters) where work could be performed on energized parts.
- C. Arc-Flash Hazard Analysis shall include all significant locations in 480V, 240V and 208V systems fed from transformers equal to or greater than 75kVA where work could be performed on energized parts.
- D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2CAL/CM².
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations
- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as

the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- J. Mis-Coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2SEC based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2SEC during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.07 REPORT SECTIONS

- A. Input data shall include, but not be limited to the following:
1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
 2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
 3. Reactor data, including voltage rating, and impedance.
 4. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance (X''_d), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
 5. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.

B. Short-Circuit Output Data shall include, but not be limited to the following reports:

1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. Equivalent impedance

2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated symmetrical fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. Calculated asymmetrical fault currents
 - 1) Based on fault point X/R ratio
 - 2) Based on calculated symmetrical value multiplied by 1.6
 - 3) Based on calculated symmetrical value multiplied by 2.7
 - e. Equivalent impedance

3. Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated symmetrical fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. No AC Decrement (NACD) Ratio
 - e. Equivalent impedance
 - f. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis
 - g. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis

C. Recommended Protective Device Settings:

1. Phase and Ground Relays:
 - a. Current transformer ratio
 - b. Current setting

- c. Time setting
 - d. Instantaneous setting
 - e. Recommendations on improved relaying systems, if applicable.
- 2. Circuit Breakers:
 - a. Adjustable pickups and time delays (long time, short time, ground)
 - b. Adjustable time-current characteristic
 - c. Adjustable instantaneous pickup
 - d. Recommendations on improved trip systems, if applicable.
- D. Incident energy and flash protection boundary calculations
 - 1. Arcing fault magnitude
 - 2. Protective device clearing time
 - 3. Duration of arc
 - 4. Arc flash boundary
 - 5. Working distance
 - 6. Incident energy
 - 7. Hazard Risk Category
 - 8. Recommendations for arc flash energy reduction

PART 3 - EXECUTION

3.01 COORDINATION

- A. Contractor shall assist and provide support as needed for the electrical equipment supplier or approved engineering firm as necessary to complete the requirements of the Specification.

3.02 FIELD ADJUSTMENT

- A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the start-up and commissioning technician of the electrical equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify Engineer in writing of any required major equipment modifications.

3.03 ARC FLASH WARNING LABELS

- A. The Contractor shall provide and install labels in accordance Specification Section(s)
 - 1. 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS.
- B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the Engineer for

review and after any system changes, upgrades or modifications have been incorporated in the system.

3.04 PROJECT CLOSEOUT

- A. Contractor shall provide the final report of that required in Section 1.4D, after incorporating any field adjustments to the equipment that effects the Short-Circuit Coordination Study and Arc Flash Hazard Analysis Study to include a table of the all the relay and protective device settings for project close-out documentation.

END OF SECTION

SECTION 26 00 10 TESTING AND COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish all labor, materials, equipment and incidentals required to providing standard electrical inspections, testing and commissioning services and required reports required under this Contract as hereinafter specified and/or in the Contract Documents.
- B. Requirements include but not limited to:
 - 1. Contractor responsibilities that are a part of or are related to the testing and commissioning process for all the electrical systems under the Electrical Scope Of Work and as related in the Contract Documents.
 - 2. Engineer will review and approve, prior to use, all test procedures and forms used and will witness, at their discretion initial checks and testing performed by the Contractor. Engineer will review the completed check and test documentation of the Contractor.
 - 3. It is not the intent under the Division 26 Specifications to duplicate Contractor efforts or to require the Contractor to perform any check or test more than twice. Electrical checks and testing by the Contractor are expected to occur once in the normal sequence of installation, testing and placing equipment into service, if appropriate coordination has occurred allowing the Engineer and/or Owner to witness Contractor efforts.
 - 4. Testing requirements listed under this Specification Section do not release the Contractor from the obligation to perform all other appropriate, industry standard, manufacturer-recommended or code-required checks and tests.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this section, the requirements of Division 26 and those Project Specification Sections referenced therein shall be applied.

1.03 REFERENCES

- A. Codes and Standards
 - 1. Institute of Electrical and Electronic Engineers (IEEE)
 - a. 43 – Recommended Practice for Testing Insulation Resistance of Rotating Machinery

- b. 450 – Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications
 - c. 519 – Recommended Practices and Requirements for Harmonics Control in Electrical Power Systems
 - d. C37.233 – Guide for Power System Protection Testing
 - e. C57.13.1 – Guide for Field Testing of Relaying Current Transformers
 - f. C57.13.3 – Guide for Grounding of Instrument Transformer Secondary Circuits and Cases
 - g. C57.104 – Guide for the Interpretation of Gases Generated in Oil-Immersed Transformers
- 2. International Electrical Testing Association (NETA)
 - a. ATS – Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems
 - b. ETT – Standard for Certification of Electrical Testing Technicians
 - 3. North American Electric Reliability Corporation (NERC)
 - a. PRC-005-2 – Protection System Maintenance
 - 4. National Electrical Manufacturers Association (NEMA)
 - a. AB4 – Guidelines for Inspection and Preventive Maintenance of Molded-Case Circuit Breakers Used in Commercial and Industrial Applications
 - b. MG1 – Motors and Generators
 - 5. National Fire Protection Association (NFPA)
 - a. 70, National Electrical Code
 - b. 70E, Standard for Electrical Safety in the Workplace

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per the Contract Specifications.
- B. Contractor shall submit written copies of all inspection and test reports to the Engineer for review and acceptance.
- C. Sixty days (60DY) before any testing is conducted, submit an overall testing plan and schedule for electrical systems that lists the equipment, modes to be tested, dates of testing and parties conducting the tests. Contractor shall place these tests into the master construction schedule and update as needed.
- D. Testing Requirements:

1. Contractor shall employ the services of a third-party NETA testing firm for all testing and commissioning of Medium Voltage (MV) Transformers, cabling including connections, and protection relays, including the settings MV feeder breakers. Additionally, the testing and commission of the 480V Main and Tie breakers, switchgear, switchboards, cable and connections and branch circuit breakers with adjustable settings.
2. Contractor shall provide a listing of testing personnel stating their experience in testing of medium-voltage (5kV through 35kV) equipment and cabling for Engineer approval.
3. Contractor shall provide a listing of testing personnel stating their experience in testing of low-voltage (600V) equipment and cabling for Engineer approval.
4. All personnel involved in testing major electrical equipment, protective relays and meters shall be certified per ANSI/NETA ETT and have a minimum of five years (5YR) experience in testing of this type of equipment; each electrical testing crew leader shall have a current certification of Level III or higher.
5. Contractor shall provide a listing of testing equipment that will be used and provide verification of calibration as applicable within the last year, prior to use and shall have dated calibration labels visible on all test equipment. Test equipment and calibration shall be in accordance with ANSI/NETA ATS Sections 5.2 and 5.3.

E. Test Equipment:

1. Contractor shall provide all test equipment necessary to fulfill the checks and testing requirements. Test equipment shall have been calibrated within one year (1YR) of its use on the Project.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Reference those applicable Specification Sections

1.06 OPERATION AND MAINTENANCE MANUALS

- A. Reference those applicable Specification Sections

1.07 WARRANTY

- A. Reference those applicable Specification Sections

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 COORDINATION

- A. Contractor shall coordinate with all trades, subcontractors, vendor representatives, with Engineer, Engineer's Representative and/or Owner prior to executing Testing and Commissioning Plan(s).

3.02 EXAMINATION

- A. Engineer reserves the right to inspect the Contractor's work at any time during the contract period. Contractor shall make all work available to the Owner and/or the Engineer, upon request.
- B. Contractor shall request Engineer review and approval at least twenty-four-hours (24HR) prior to covering of any concealed work; pulling of wires and cables; or placing covers over outlets, cabinets, panel boards, switchboards, or switchgear.
- C. Perform additional tests required under other Specification Sections required under Division 26. Written reports of all test results shall be submitted to Engineer for review.
- D. Notify Engineer of any deficiencies that are found during the tests; after deficiencies are corrected, repeat tests until the system is approved. When applicable, electrical work shall not be covered or concealed until satisfactory tests are made and approved.
- E. Upon request from the Owner and/or Engineer, place the entire electrical installation or any portion thereof, in operation to demonstrate satisfactory operation.
- F. Contractor shall inspect and test all materials and equipment, including all furnished major equipment under this Contract, using the latest edition of the ANSI/NETA ATS – Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems as a guide. The ANSI/NETA ATS specifications apply to testing of all electrical equipment and cabling installed and/or modified under this Project prior to placing into service.

3.03 INSPECTION AND TESTING

- A. Inspections and testing procedures shall include but not limited to the following:
 - 1. Transformers, Dry-Type: ANSI/NETA ATS Section 7.2.1.1
 - 2. Transformers, Liquid-Filled: ANSI/NETA ATS Section 7.2.2
 - 3. Cables, Low-Voltage 600V: ANSI/NETA ATS Section 7.3.2
 - 4. Cables, Medium-Voltage 35kV: ANSI/NETA ATS Section 7.3.3

5. Grounding Systems: ANSI/NETA ATS Section 7.13
 6. Adjustable Speed Drive Systems: ANSI/NETA ATS Section 7.17
 7. Engine Driven Generator: ANSI/NETA ATS Section 7.22.1
- B. Test Reports: All testing results, evaluations and operational/functionality reports for all equipment and cabling installed and/or modified under this Contract shall be recorded in a formal report and submitted to the Engineer for review.

3.04 COMMISSIONING

- A. The following are Contractor responsibilities applicable to all electrical systems being commissioned and/or placed into service.
1. Document all electrical testing and commissioning forms submitted to and approved by the Engineer prior to placing equipment into service.
 2. Notify the Engineer immediately when commissioning activities not yet performed or not yet scheduled will delay construction.
 3. Respond to deficiencies identified during the commissioning process, making required corrections or clarifications and returning prompt notification to the Engineer.
 4. When completion of a task or other issue has been identified as holding up any commissioning process, particularly functional testing, the Contractor shall, within two days (2DY) notify the Engineer in writing providing an expected date of completion.
 5. Develop check and testing procedures with start-up and/or commissioning plan for Engineer review.
 6. Review design documents, shop drawings and O&M manuals along with manufacturer recommended installation and testing procedures.
 7. Develop test procedures and forms and execute and document testing.
 8. Tests of energized equipment shall be conducted when the equipment is operating at its normal capacity. This may require some tests to be conducted after occupancy.

3.05 TRAINING AND ORIENTATION

- A. Contractor shall provide orientation and training to facility personnel as required in Division 26 and those Project Specification Sections.

3.06 PROJECT CLOSE-OUT

- A. Contractor shall provide all Testing and Commissioning test results and corrective actions in one (1) comprehensive report for Project close-out requirements.

END OF SECTION

SECTION 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish and install but not limited to the following equipment and warning labels:
 - 1. Equipment Identification Nameplates
 - 2. Conduit/Raceway:
 - a. Identification Tags
 - b. Voltage System Warning Labels
 - 3. Wire/Cable Bundles Identification Tags
 - 4. Wire Markers and Cable Color Coding
 - 5. Electrical Hazards Information
 - a. Electrical Signage
 - b. Shock Hazard Warning Labels
 - c. Arc-Flash Warning Labels
 - 6. Working Space Markings
 - 7. Duct-Bank Systems Warning Tape

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this Section, the requirements of Division 26 and those Project Specification Sections referenced therein shall be applied.
- B. Related Specification Sections include but not limited to:
 - 1. Section 26 05 19 – LOW-VOLTAGE CONDUCTORS AND CABLES

1.03 REFERENCES

- A. Conform to requirements of the National Electrical Code (NEC), NFPA 70E, and OSHA, Codes and Standards
 - 1. Conform to applicable requirements of the following ANSI Standards:
 - a. Z535.1 Safety Color Codes
 - b. Z535.2 Environmental and Facility Safety Signs
 - c. Z535.3 Criteria for Safety Symbols and Labels
 - d. Z535.4 Product Safety Signs and Labels
 - e. Z535.5 Safety Tags and Barricade Tapes (for Temporary Hazards)

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per the Contract Specifications.
- B. Contractor shall submit the following:
 - 1. Catalog Data: Submit manufacturer's catalog literature for each product.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
 - 3. Samples:
 - a. Submit two (2) samples of each type of printed and stamped identification products applicable to the Project.
 - b. Submit two (2) nameplates illustrating materials and engraving quality.
 - 4. Submit an Electrical Systems Raceway Schedule for all power, control, signal, process tele/comm/data raceway systems that aligns with CFPUA equipment identification and tagging scheme.
 - 5. Electrical Systems Raceway Schedule shall be submitted for Engineer review in an electronic spreadsheet type Excel compatible file format. Electrical Systems Raceway Schedule shall include but not limited to the following data:
 - a. Raceway ID Tag
 - b. Raceway size, type and quantity
 - c. Routing
 - 1) duct-bank sections, pull-boxes, hand-holes, marshalling and termination cabinets, etc.
 - d. Spare Raceway ID Tag
 - e. Spare Raceway type, size and quantity
 - f. Contractor additional notes
 - 6. Submit an Electrical Wire Schedule for all power, control, signal, process tele/comm/data, protective circuitry, wiring, conductors, etc. that aligns with the Electrical Systems Raceway Schedule.
 - 7. Electrical Wire Schedule shall be submitted for Engineer review in an electronic spreadsheet type Excel compatible file format. Electrical Wire Schedule shall include but not limited to the following data:
 - a. Raceway ID Tag
 - b. Cable/Conductor/Wire ID Tag
 - c. Cable/Conductor/Wire type, size, quantity and rated voltage
 - d. Terminations

- 1) terminal block numbers
- 2) supply, origin, source, etc.
- 3) intermediate terminations and/or splices, e.g. marshalling and termination cabinets
- 4) utilization and/or field device, spares, etc.
- 5) line, load, lug, terminal block or connection identification

e. Contractor additional notes

8. Engineer Note: Electrical Systems Raceway Schedule and Electrical Wire Schedule can be combined into one (1) submittal document.
9. Schedules shall be submitted for Engineer review in an electronic spreadsheet type Excel compatible file format. The marker schedule shall incorporate the following alpha-numeric scheme:

a. Prefix, first letter shall indicate the associated system

A – Analogue	(PLC/DCS variable signals <90V)
C – Control	(Motor/Control signals >90V)
D – Discrete	(PLC/DCS step signals <90V)
E – Data Communications	(Data Systems, EtherNet, WiFi, etc.)
F – Fire Alarm/Annunciation	(Fire Alarm Systems and Devices)
H – PLC/DCS Communications	(ModBus, Profibus, ControlNet, etc.)
P – Power	(Power feeder, branch circuits >115V)
T – Telephone/Voice	(Telephone/Voice Systems copper or fiber)
V – Video	(CCTV/Video Monitoring Systems)
Z – Security	(Security Systems)

b. Prefix, second letter (if applicable or used)

C – Copper Media	(Copper signal conductors)
F – Fiber Optic Media	(Fiber single-mode, multi-mode, etc.)
K – High Voltage	(Power feeder, branch circuits >600V)

c. Prefix, third letter (if applicable or used)

N – Non-Secured/Un-Classified (Open,non-secured/un-classified systems)

F – Secured/Classified (Closed, secured/classified systems)

d. Root, alpha-numeric lettering as required and in accordance with the P&ID unique identifiers to reflect the equipment/device; examples:

FIT-20, PLC-1, VFD-4500, FCV-5010

e. Suffix, numeric indexed as required to coincide with the number of cables and/or conductors used; examples:

0100, 0110, 0120...0900

10. Sample Cable/Wire marker format should resemble the following:

1.05 DELIVERY, STORAGE AND HANDLING - NOT USED

1.06 OPERATION AND MAINTENANCE MANUALS - NOT USED

1.07 WARRANTY - NOT USED

1.08 IDENTIFICATION - NOT USED

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents all Identification for Electrical Systems products shall be provided by one manufacturer for each product type:

1. Brady
2. Electromark
3. Hazard Communication Systems
4. Hellermann Tyton
5. LEM Products
6. Panduit
7. Seton Name Plate
8. Safety Label Solutions
9. Approved Acceptable as Specified in the Owner's Approved Products List

2.02 EQUIPMENT IDENTIFICATION NAMEPLATES

A. Furnish equipment nameplates as specified and as shown on the Contract Documents to indicate the unique equipment identifiers.

1. UV stabilized phenolic material rated for outdoor applications and 200F.
2. WHITE lettering on BLACK background.
3. 6IN by 1.5IN minimum.

- B. Use the following equipment identification nameplate as a basis of design:

2.03 CONDUIT/RACEWAY IDENTIFICATION TAGS

- A. Furnish and install conduit/raceway identification tags for all conduit, raceway, wire-way, cable-tray and wire-through, etc. to include but not limited to the following systems:
 - 1. Power Systems
 - 2. PLC/DCS Control Systems
 - 3. Telephone/Voice/Data Systems
 - 4. Fire Alarm and Security Systems
 - 5. Video/CCTV Systems
- B. All conduit/raceway identification tags shall conform to the following unless otherwise noted on the Contract Documents.
 - 1. Indoor areas: UV stabilized phenolic
 - 2. Indoor wet/corrosive areas: stainless steel 316L
 - 3. Outdoor areas: aluminum 6063-T6 or stainless steel 304L
 - 4. Outdoor corrosive areas: stainless steel 316L
- C. Use the following conduit/raceway identification tags as a basis of design:
- D. Reference previous Section 1.4B.4.

2.04 VOLTAGE SYSTEM WARNING LABELS

- A. Furnish and install voltage system warning labels for transformers, switchgear, panelboards, starters, motor control centers, safety switches, pull boxes, cabinets, and raceways.
- B. Provide flexible pressure sensitive vinyl markers with minimum 1IN by 4IN ORANGE or RED or background with BLACK lettering.
- C. Use the following warning label as a basis of design:
- D. Provide voltage markers with lettering indicating the highest voltage present:
 - 1. 120V system: 120 VOLTS
 - 2. 208/120V system: 208 VOLTS
 - 3. 120/240V and 240V systems: 240 VOLTS
 - 4. 480/277V and 480V systems: 480 VOLTS
 - 5. 4160/2400V systems: 4160 VOLTS

2.05 WIRE/CABLE BUNDLE IDENTIFICATION TAGS

- A. Provide and install to each wire/cable bundle routed through man-holes, hand-holes, electrical vaults, etc. laser etched stainless-steel tag with mounting holes to receive black, uv-resistant cable ties with the corresponding information in the approved Electrical Wire Schedule.

B. Use the following wire/cable bundle tags as a basis of design:

1. Reference previous Section 1.4B.5.

2.06 WIRE MARKERS

A. Provide and install wire markers for but not limited to; power, control, instrumentation, fire alarm, tele/comm, video, security and video circuit wires.

B. Furnish polyolefin whole and/or split sleeve, heat-shrinkable wire markers, size as required per wire, conductor, cable, etc.

C. Locate a wire marker on each and every cable, conductor or wire at switchgear, MCC, panelboards, pull boxes, outlet and junction boxes, and at each landed termination.

D. Provide and install typewritten BLACK lettering on WHITE label markers as follows but not limited to:

1. Power and lighting circuits: as-built branch circuit or feeder circuit number.
2. Motor control circuits: as-built control wire number or equipment manufacturer's wiring diagrams.
3. PLC/DCS signals
4. Telephone/Data Communications circuits
5. Fire Alarm and Security circuits
6. Video/CCTV circuits

E. Use the following warning label as a basis of design:

1. .Reference previous Section 1.4B.5.

2.07 CABLE COLOR CODING

A. Color Coding

1. Unless otherwise noted on the Contract Documents, conductor insulation shall be color coded as follows:

a. 4160/2400V AC Power:

Phase A – BLACK

Phase B – RED

Phase C – BLUE

Grounding/Earthing conductors – GREEN

b. 480V AC Power:

Phase A - BROWN

Phase B - ORANGE

- Phase C - YELLOW
 - Neutral – GREY
 - c. 120/208V or 120/240V AC Power:
 - Phase A - BLACK
 - Phase B - RED
 - Phase C - BLUE
 - Neutral – WHITE
 - d. 120VAC Control:
 - Ungrounded conductors – RED
 - Ungrounded conductors, foreign source - YELLOW.
 - e. 24VAC Control:
 - All wiring – ORANGE
 - f. 24VDC Power:
 - Positive Lead – RED
 - Negative Lead – BLACK
 - g. 24VDC Control:
 - Ungrounded conductors – BLUE
 - Grounded conductors – BLUE w/ WHITE stripe
 - h. Equipment Grounding Conductor:
 - All wiring – GREEN
2. Conductors #4AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be coded by the use of colored heat-shrinkable tubing.

2.08 WARNING SIGNS

- A. Furnish warning signs for low-voltage and medium-voltage transformers, switchgear, switchboards, panelboards, motor starters, motor control centers, safety switches, pull boxes, and cabinets.
- B. Use warning signs that conform to ANSI Z535.4 and OSHA Danger and Caution specifications.
- C. Provide minimum 2IN by 4IN warning signs.

- D. Provide warning signs with format and lettering as follows:
 - 1. Signal word: DANGER
 - 2. Signal word panel color: RED with safety alert symbol.
 - 3. Word message: HAZARDOUS VOLTAGE SHOCK, BURN OR DEATH
 - 4. Safety symbol: ISO 3864 "lightning bolt" in YELLOW triangle.

- E. Materials:
 - 1. For indoor applications use flexible, pressure sensitive, polyester base with polyester overlamine.
 - 2. For outdoor applications use aluminum signs.

2.09 ARC FLASH AND SHOCK HAZARD WARNING LABELS

- A. Supplier of Arcflash Study shall furnish Arcflash labeling per NFPA 70E for the CONTRACTOR to install arc flash and shock hazard warning labels for switchgear, transformers, panelboards, industrial control panels, motor controllers (including those furnished with mechanical equipment), motor control centers, safety switches, and other equipment as required by the NEC or NFPA 70E.

- B. Provide warning labels that comply with ANSI Z535.4. Color in top part of WARNING sign shall be ANSI "safety orange." Color in top part of DANGER sign shall be RED. All lettering on labels shall be BLACK.

- C. Provide either machine-produced custom labels or manually filled-in pre-printed labels similar in design to those below.
 - 1. Label dimensions shall be approximately 4IN height by 5IN width.
 - 2. Outdoor labels shall be suitable for a high-UV environment.
 - 3. Machine-produced custom labels:
 - a. Use polyester label stock that is NRTL-recognized to UL969, Marking and Labeling Systems, and has a high adhesion adhesive back.
 - b. Use printing ribbon recommended by the label stock manufacturer.
 - c. Use a suitable thermal transfer process label-printing machine to generate labels and enter the application-specific information indicated in the installation sub-paragraphs.
 - 4. Pre-Printed labels:
 - a. Use labels printed on self-adhesive UV-resistant polyester with pressure-sensitive adhesive back. Provide labels with a clear polyester overlay film to protect information.

- D. Use the following warning label design as a basis of design:

2.10 WORKING SPACE FLOOR MARKING

- A. Provide BLACK and WHITE paint rated for the floor application to mark the NEC-required working space on the floor at electrical equipment that is likely to require examination, adjustment, servicing, or maintenance while energized.

2.11 WORKING SPACE LABELS

- A. Provide labels indicating required working clearance at electrical equipment that is likely to require examination, adjustment, servicing, or maintenance while energized and it is impractical mark the NEC-required working space on the floor.
- B. Material:
 - 1. Use polyester label stock that is NRTL-recognized to UL969, Marking and Labeling Systems, and has a high adhesion adhesive back.
 - 2. Use printing ribbon recommended by the label stock manufacturer.
 - 3. Use a suitable thermal transfer process label-printing machine to generate labels and enter the application-specific information
 - 4. Outdoor labels shall be suitable for a high-UV environment.
- C. Minimum dimensions: 3.5IN by 1.25IN.
- D. Use the following warning label design as a basis of design for this scope of work:

NOTICE

Keep area in front of this electrical equipment clear for #-##/## feet.
OSHA-NEC regulations.

- 1. Signal word: "NOTICE" in 24-point minimum white italic letters on safety blue panel.
- 2. Word message: 16-point minimum black or safety blue letters on white background.
 - a. Word message for 120/240V and 208/120V equipment: "Keep area in front of this electrical equipment clear for 3FT. OSHA-NEC regulations."
 - b. Word message for 480V and 480/277V equipment with exposed live parts on one side of the working space and no live parts on the other side of the working space: "Keep area in front of this electrical equipment clear for 3.5FT OSHA-NEC regulations."
 - c. Word message for 480V and 480/277V equipment with exposed live parts on both sides of the working space: "Keep area in front of this electrical equipment clear for 4FT OSHA-NEC regulations."

2.12 DUCT-BANK SYSTEMS WARNING TAPE

- A. Provide detectable underground warning tape for underground electrical systems as required and in accordance with the NEC and the Contract Documents.

1. Reference Specification Section: 26 05 43 – UNDERGROUND DUCTBANK SYSTEMS, MANHOLES AND HANDHOLES
- B. Material:
 1. 5-MIL tape thickness with aluminum backing and 2-MIL clear laminated finished over lettering
 2. Warning tape shall comply with APWA approved colors
- C. Dimensions: 6IN by 1000FT

PART 3 - EXECUTION

3.01 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, and manufacturer's wiring diagrams, with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Verify electrical equipment designations and unique equipment identifiers with Engineer, Engineer's Representative and/or Owner.

3.02 EXAMINATION

- A. Examine surfaces to receive identification products for compliance with installation tolerances and other conditions affecting performance of the identification products. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.03 INSTALLATION - GENERAL

- A. Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
- B. Install labels at locations for best convenience of viewing without interference with operation and maintenance of equipment.
 1. Coordinate installation of identifying devices with location of access panels and doors.
 2. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Install electrical identification products only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.
- D. Prepare, clean and/or de-grease surfaces where electrical identification product is to be placed.
- E. Place electrical identification products centered and parallel to equipment lines.

3.04 EQUIPMENT NAMEPLATES

- A. Install equipment nameplates on the front of each piece of new electrical equipment to transformers, panelboards, lighting panelboards, safety switches, enclosed circuit breakers, etc.
- B. Position equipment nameplates so they can be read from the front of the enclosure, cabinet, etc.
- C. Use manufacturer's recommended adhesive for engraved tags and nameplates.
 - 1. Additionally, equipment nameplates shall be fastened with stainless-steel machine screws; self-tapping fasteners are not acceptable and will be rejected to include re-placement of enclosure.

3.05 CONDUIT/RACEWAYS

- A. Identification Tags
 - 1. Install identification tags in accordance with the approved Electrical Systems Raceway Schedule on all but not limited to; power, control, data, fire, tele/comm, video and security system conduit and raceways.
 - 2. Permanently attach laser-etched stainless-steel conduit/raceway tags with stainless steel wire and permanent crimp seal to each exposed terminal end of all conduit runs entering all electrical equipment such as switchgear, switchboards, motor control centers, control panels, pull/junction boxes, utilization equipment, and at each point leaving or entering a structure or building.
 - 3. Position identification tags so they can be read from finished floor/grade visible and vertically or horizontally.
 - a. Engineer reserves the right during project close-out procedures that Contractor re-position and/or supplement conduit and raceway identification as Engineer and/or Owner requires at no additional cost.
 - 4. Furnish identification tags for all conduit, raceway, wire-way, cable-tray and wire-through, etc. at each enclosure, equipment, junction/pull box, termination cabinet, etc. at terminal ends.

3.06 VOLTAGE SYSTEM WARNING LABELS

- A. Install voltage system warning labels to all transformers, switchgear, panelboards, starters, motor control centers, safety switches, pull boxes, cabinets, and conduit/raceway systems.
 - 1. Labels shall indicate the maximum voltage present with enclosures, equipment and conduit/raceway.

- B. Electrical Equipment
 - 1. Front and rear of each free-standing switchgear, switchboard and motor-control-center section.
 - 2. Front of each transformer, panelboard, industrial control panel, enclosed circuit breaker, safety switch, and motor controller enclosure, including those furnished with mechanical equipment.
 - 3. Front cover of each pull/junction box containing low-voltage or medium-voltage conductors.

- C. Conduit/Raceways
 - 1. Install voltage system warning labels to each exposed terminal end of all conduit runs entering all electrical equipment such as switchgear, switchboards, motor control centers, control panels, pull/junction boxes, utilization equipment, and at each point leaving or entering a structure or building.
 - a. Labels shall be applied to conduit/raceway systems at intervals no greater than twenty feet (20FT) along entire conduit/raceway run.
 - b. Position labels so they can be read from finished floor/grade and vertically or horizontally.

3.07 WIRE/CABLE BUNDLES IDENTIFICATION TAGS

- A. Install in electrical vaults, man-holes, hand-holes, and underground pull/junction boxes. Vaults only in substitution of stainless-steel conduit/raceway tag identification system.
- B. Provide laser-etched stainless-steel tag with uv-resistant cable ties attached to a minimum of one (1) wire/cable bundle associated with each raceway.
- C. All wire/cable bundles shall be tagged with its approved tag number per the approved Electrical Wire Schedule immediately after it has been pulled.

3.08 WIRE MARKERS AND CABLE COLOR CODING

- A. Install wire markers on all but not limited to; power, control, data, fire, tele/comm, video and security system conductors within all termination, splicing, marshalling, junction-box, devices, cabinets and enclosures.
- B. Install wire markers within all switchgear, switchboards, motor control centers, panelboards, lighting panelboards, safety switches, etc.
 - 1. Wire markers shall be installed on all terminated/spliced wire, cable and conductor ends regardless of the number of enclosures that they are routed through.
 - 2. Contractor shall inspect and ensure that all wire markers match on all terminated/spliced ends and correspond with the approved Cable/Wire marker schedule.

3. Engineer reserves the right during project close-out procedures that Contractor re-install wire markers as Engineer and/or Owner requires at no additional cost.
- C. Position wire markers so they can be read when opening the enclosure door and without rotating the wire/conductor when landed on terminal strips.
- D. Contractor shall re-install wire markers that are blurred, smudged, ill-legible, mis-printed, damaged or soiled at no additional cost.

3.09 WARNING SIGNS

- A. Install warning signs at the following locations and position signs so they can be read from floor or ground:
 1. Front and rear of each low-voltage switchgear or switchboard section.
 2. Front of each low-voltage transformer, switchboard, panelboard, industrial control panel, motor control center, enclosed circuit breaker, safety switch, and motor starter enclosure including those furnished with mechanical equipment.

3.10 ARC FLASH AND SHOCK HAZARD WARNING LABELS

- A. Install arc flash and shock hazard warning labels at the following locations and position signs so they can be read from floor or ground:
 1. Front and rear of each freestanding low-voltage switchgear or switchboard section.
 2. Front of each low-voltage transformer, panelboard, industrial control panel, motor control center, enclosed circuit breaker, safety switch, and motor controller enclosure, including those furnished with mechanical equipment.
 3. Cover of each pull box containing exposed low conductors.
- B. Enter the following application-specific information in arc-flash and shock hazard warning labels as required under Specification Section 26 00 05:
 1. Arc-Flash Protection Boundary (inches) calculated in accordance with IEEE Std 1584 or NFPA 70E.
 2. Arc-flash incident energy (cal/cm²) calculated in accordance with IEEE Std 1584 or NFPA 70E.
 3. Working distance (inches) selected from IEEE Std 1584 or NFPA 70E (Annex D) based on equipment type.
 4. Hazard/risk category number from NFPA 70E Table 130.7(C)(9) for operations with doors closed and covers on.
 5. System phase-to-phase voltage.
 6. Condition that exposes worker to an electrical shock hazard.
 7. Limited Approach Boundary from NFPA 70E Table 130.2(C) based on nominal system phase-to-phase voltage.

8. Restricted Approach Boundary from NFPA 70E Table 130.2(C) based on nominal system phase-to-phase voltage.
9. Prohibited Approach Boundary from NFPA 70E Table 130.2(C) based on nominal system phase-to-phase voltage.
10. Class for insulating gloves based on system voltage (e.g. Class 00 for up to 500 volts).
11. Voltage rating for insulated or insulating tools based on system voltage (e.g. 1000 volts).
12. Equipment ID code based on Drawings and including TA number, building number, and system identifier.
13. Date that hazard analysis was performed.
14. "Served from" circuit directory information including the serving equipment ID code, location (e.g. room number), circuit number, and circuit voltage/phases/wires.
15. If applicable, "serves" circuit directory information including the served equipment ID code, location (e.g. room number), circuit number, and circuit voltage/phases/wires.

3.11 WORKING SPACE FLOOR MARKERS

- A. Install floor marking paint on the floor at the locations listed below to indicate the working space required by the NEC.
 1. Front and rear of each free-standing low-voltage switchgear or switchboard section.
 2. Front of each low-voltage transformer, switchboard, panelboard, industrial control panel, motor control center, enclosed circuit breaker, safety switch, and motor controller enclosure including those furnished with mechanical equipment.
 3. Any other equipment likely to require examination, adjustment, servicing, or maintenance while energized.

- B. Dimensions of working space area shall be as follows:
 1. Width: the greater of the width of the equipment or 30IN.
 2. Depth:
 - a. 120/240V and 208/120V equipment: 3FT
 - b. 480V and 480/277V equipment with exposed live parts on one side of the working space and no live parts on the other side of the working space: 3.5FT.
 - c. 480V and 480/277V equipment with exposed live parts on both sides of the working space: 4FT.
 - d. 4160/2400V equipment with exposed live parts on one side of the working space and no live parts on the other side of the working space: 4.5FT.

- e. 4160/2400V equipment with exposed live parts on both sides of the working space: 6.5FT.
- C. Thoroughly prepare floor surface to receive paint.
- D. Paint the NEC-required working space area with alternating 3 to 6IN wide black and white diagonal stripes.

3.12 WORKING SPACE LABELS

- A. Install working space labels at the following locations only in cases where it is impractical to mark the NEC-required working space on the floor (e.g. carpeted areas).
 - 1. Front of each low-voltage switchgear or switchboard section and rear of each freestanding low-voltage switchgear or switchboard section.
 - 2. Front of each meter enclosure, low-voltage transformer, panelboard, industrial control panel, motor control center, enclosed circuit breaker, safety switch, and motor controller enclosure, including those furnished with mechanical equipment.
 - 3. Any other equipment likely to require examination, adjustment, servicing, or maintenance while energized.
- B. Position labels so they can be read from floor or ground.

3.13 DUCT-BANK SYSTEMS WARNING TAPE

- A. Provide warning tape(s) as follows:
 - 1. Electrical duct-bank systems, trenches and raceways:
 - a. Legend: "CAUTION CAUTION CAUTION" (1st line), "BURIED ELECTRIC LINE" (2nd line).
 - b. Letters: 1 1/4IN minimum.
 - c. Interval: Continuous.
 - d. Color: BLACK lettering on RED background.
 - 2. Tele-Communication duct-bank systems, trenches and raceways:
 - a. Legend: "CAUTION CAUTION CAUTION" (1st line), "BURIED TELEPHONE LINE" (2nd line).
 - b. Letters: 1 1/4IN minimum.
 - c. Interval: Continuous.
 - d. Color: BLACK lettering on ORANGE background.
 - 3. SCADA duct-bank systems, trenches and raceways:
 - a. Legend: "CAUTION CAUTION CAUTION" (1st line), "BURIED COMPUTER LINE" (2nd line).

- b. Letters: 1 1/4IN minimum.
- c. Interval: Continuous.
- d. Color: BLACK lettering on ORANGE background.

3.14 ATTACHMENTS

- A. Typical Installation Drawings
 - 1. Cable Identification Detail
 - 2. Conductor Termination and Identification Detail

END OF SECTION

SECTION 26 05 01 – EXCAVATION AND CONCRETE WORK FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish all labor, materials, equipment and incidentals required to complete electrical systems that require excavation and/or concrete work as required under this Contract as hereinafter specified and/or shown in the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this section, the requirements of Division 26 and those Project Specification Sections referenced therein shall be applied.
- B. Related Specification Section(s) include but not limited to
 - 1. 03 30 00 – CAST – IN – PLACE CONCRETE
 - 2. 26 05 33.13 – ELECTRICAL RACEWAY SYSTEMS
 - 3. 26 05 43 – UNDERGROUND DUCTBANKS FOR ELECTRICAL SYSTEMS

1.03 REFERENCES

- A. Codes and Standards
 - 1. American Concrete Institute (ACI)
 - a. 211.1 Proportioning Concrete Mixtures
 - b. 301 Specifications for Structural Concrete
 - c. 303.1 Specification for Cast-in-Place Architectural Concrete
 - d. 305 Hot Weather Concreting
 - e. 306 Specifications for Cold Weather Concreting
 - f. 308 Specifications for Curing Concrete
 - g. 309 Consolidation of Concrete
 - h. 318 Building Code Requirements for Structural Concrete

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per Specification Section(s)

1. 01 33 00 - Shop Dwgs, Project Data and Samples
 - A. Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification Section.
 - B. Shop drawings shall include but not be limited to
 1. Equipment specifications and product data sheets identifying all materials used and methods of fabrication.
 2. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.
 - C. Existing Conditions
 1. Contractor shall coordinate and sequence of the excavation Scope Of Work, so as not to cause shutdown of operations, process and comply with those as requirements per Specification Section(s)
 - a. 26 00 00 – ELECTRICAL BASIC REQUIREMENTS
 2. Contractor shall protect property from any and all damage that might result from excavating and backfilling.
 3. Contractor shall protect all persons from injury at excavations, by barricades, warnings and illumination.
 4. Coordinate excavations with weather conditions, to minimize possibility of washouts, settlements and other damages and hazards.
 - D. Qualifications
 1. Manufacturers: Firms regularly engaged in manufacture of products for electrical related work of sizes, types, ratings, and materials required, whose products have been in satisfactory use in similar service for not less than three (3) years.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Reference those applicable Specification Sections

1.06 OPERATION AND MAINTENANCE MANUALS

- A. Reference those applicable Specification Sections

1.07 WARRANTY

City of Clearwater

NE WRF MCC-1, DC1 & 2 REPLACEMENT *Excavation and Concrete Work for Electrical Systems*
17-0028-UT 26 05 01-2
00992-0254

- A. Reference those applicable Specification Sections
- 1.08 IDENTIFICATION**

- A. Contractor shall reference and provide all identification, tagging and labeling for electrical and control systems as required per Specification Section(s)

- 1. 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 COORDINATION

- A. Contractor shall coordinate with all trades, subcontractors, vendor representatives, with Engineer, Engineer's Representative and/or Owner prior to executing excavation and concrete Scope Of Work.

3.02 EXCAVATION

- A. General: Do not excavate for electrical work until the work is ready to proceed without delay, so that total time lapse from excavation to completion of backfilling will be minimized.
- B. Excavate with vertical-sided excavations to greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger the work or other property. Where not removed, cut sheeting off at sufficient distance below finished grade to not interfere with other work.
- C. Excavations shall not interfere or adversely compromise structural foundations, elements or features. Excavations that encroach structural foundations, elements or features shall be coordinated with structural Engineer of Record prior to commencing work.
- D. Depth for sub-base Support: Unless otherwise noted, provide installation of sub-base material(s). Excavate for installation of sub-base material in depth indicated or, if not otherwise indicated, 6IN below bottom of work to be supported.
- E. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
 - 1. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

2. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
- F. Excavate trenches to the uniform dimensions required for the particular item(s) to be installed and provide sufficient working clearances. Dig trenches to approximate depth and hand grade bottom to accurate elevation as required.
- G. Where rock is encountered, carry excavation 6IN below required elevation and backfill with a 6IN layer of sand prior to installation of conduit.
- H. Where soil conditions at bottom of indicated excavation are unsatisfactory, excavate additional depth as directed to reach satisfactory soil-bearing condition. Backfill with sub-base material compacted as directed, to indicated excavation depth.
- I. Unless otherwise noted in the Contract Documents, store excavated material (temporarily) near excavation, in manner that will not interfere with or damage excavation or other work. Do not store under trees (within drip-line).
- J. Retain excavated material that complies with requirements for backfill material.
- K. Dispose of excess or unsatisfactory excavated material(s) as directed by the Contract requirements and site conditions.
- L. Refer to the Contract requirements and site conditions for removal of large subsurface materials.

3.03 DEWATERING

- A. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
- B. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.
- C. Maintain dry excavations for electrical work, by removing water. Protect excavations from inflow of surface water. Pump minor inflow of ground water from excavations; protect excavations from major inflow of ground water, by installing temporary sheeting and waterproofing. Provide adequate barriers that will protect other excavations and below-grade property from being damaged by water, sediment or erosion from or through electrical work excavations.

3.04 BASE PREPARATION

- A. Install sub-base material to receive electrical work, and compact by tamping to form a firm base for the work.
- B. Provide finely-graded sub-base material for equipment to be buried.
- C. Tamp fill to uniform compacted density.
- D. Where conduit crosses over areas which have been previously excavated to depths greater than required for conduit installation, provide suitable support that comply with details shown and Contract requirements.

3.05 BACKFILLING

- A. Backfill with approved backfill materials.
- B. Backfill with finely-graded subbase material to 6IN above equipment to be buried. Backfill materials shall be soil materials free of clay, rock or gravel larger than 3/4IN, debris, waste, frozen materials, vegetation and other deleterious matter.
- C. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to required densities. Do not backfill with frozen soil materials.
- D. Backfill simultaneously on opposite sides of electrical work, and compact simultaneously; do not dislocate the work from installed positions.
- E. Backfill excavations in 8IN high courses of backfill material, uniformly compacted to the following densities (% of maximum density, ASTM D 1557), using power-driven hand-operated compaction equipment.
- F. When backfilling excavations for electrical work, backfill to elevations matching finished grades.
- G. Backfill trenches with concrete where trench excavations pass within 18IN of column or wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of bottom of adjacent footing.
- H. Do not backfill trenches until tests and inspections have been made and backfilling authorized by the Engineer. Use care in backfilling to avoid damage or displacement of conduit systems.

3.06 INSTALLATION OF CONCRETE

- A. Refer to Specification Section(s)
 - 1. 03 30 00 – CAST – IN – PLACE CONCRETE
- B. Miscellaneous Concrete Work
 - 1. Concrete Grouting: Grout openings and recesses as indicated on the Contract Documents and around all electrical work and other work that penetrates or adjoins all concrete work. Provide formwork where required, and tamp, screed and trowel surfaces. Cure grout as specified for concrete work.
 - 2. Refer to Specification Sections for grouting of equipment base plates on foundations (with high-strength, non-shrinking grout), and similar grouting requirements not defined herein.
- C. Clean-Up: Upon completion of work, clean excess concrete and grout from adjacent areas and surfaces. Remove excess concrete and grout by proper methods of removal, using care not to scratch or otherwise damage finished surfaces.

3.07 SUPPORT AND FASTENERS

- A. Contractor shall reference and provide all hangers, supports, equipment racks, etc. for all electrical equipment components and devices as required per Specification Section(s)
 - 1. 26 05 29 – ELECTRICAL HANGERS AND SUPPORTS
- B. Concrete or Masonry Inserts
 - 1. Contractor shall be responsible for the furnishing and installation of all conduit sleeves, anchor bolts, masonry inserts, and similar devices required for installation of equipment furnished under this Contract.
 - 2. Aluminum support members shall not be installed in direct contact with concrete. Stainless steel or non-metallic ABS plastic spacers shall be used to prevent contact of aluminum with concrete.
 - 3. Contractor is responsible for the design of supporting structures and shall submit design details to the Engineer for acceptance before proceeding with the fabrication and installation.
 - 4. Wherever dissimilar metals come into contact, the Contractor shall isolate these metals as required with UV resistant nylon washers or 9MIL polyethylene tape or gaskets.

3.08 PROJECT CLOSEOUT

A. Contractor shall reference those requirements listed in Specification Section(s)

1. 26 05 43 – UNDERGROUND DUCTBANKS FOR ELECTRICAL SYSTEMS

END OF SECTION

SECTION 26 05 19 – LOW-VOLTAGE POWER AND CONTROL WIRE AND CABLE

PART 1 - GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish, install, connect, test, and place in satisfactory operating condition, ready for service, all cables and wires indicated on the Contract Documents and as specified herein or required for proper operation of the installation, with the exception of internal wiring provided by electrical equipment manufacturers. The work of connecting cables to equipment, machinery, and devices shall be considered a part of this Section. All hardware, junction boxes, bolts, clamps, insulators, and fittings required for the installation of cable and wires system shall be furnished and installed by the Contractor
- B. The wire and cable to be furnished and installed for this Project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten years (10YR).

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this section, the requirements of Division 26 and those Project Specification Sections referenced therein shall be applied.
- B. Related Specification Sections include but not limited to:
 - 1. DIVISION 26.
 - 2. 26 05 33.13 – ELECTRICAL RACEWAY SYSTEMS

1.03 REFERENCES - NOT USED

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per the Contract Specifications.
- B. Contractor shall obtain from the wire and cable manufacturer and submit the following:
 - 1. Shop Drawings
 - a. Drawings shall include, but not limited to, detailed specifications and product data sheets for all cabling required for this Project.

- b. Material specifications and product data sheets identifying all materials used and methods of fabrication.
- c. Cable and wire identification methods and materials.
- d. Reports of Certified Shop and Field Tests

2. Electrical Raceway and Cable Schedule

- a. Submit an Electrical Raceway and Cable Schedule that aligns with the requirements in Section 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS for all power, control, signal, process, data and protective circuits. The schedule shall be submitted for Engineer review in an electronic spreadsheet type Excel compatible file format. The schedule shall include but not limited to the following data:

- 1) Raceway ID Tag
- 2) From Description and ID Tag
- 3) To Description and ID Tag
- 4) Cable/Conductor/Wire type, size and number
- 5) Raceway type and size
- 6) Service, e.g. voltage, data, communications
- 7) Ductbank Call-Outs, if installed and/or routed
- 8) Contractor additional notes

C. Submittals shall be identified by the applicable Specification Section.

1.05 DELIVERY, STORAGE AND HANDLING - NOT USED

1.06 OPERATION AND MAINTENANCE MANUALS - NOT USED

1.07 WARRANTY - NOT USED

1.08 IDENTIFICATION

- A. All cable, wires and conductors shall be identified as specified in Section PART 3, EXECUTION.

PART 2 – PRODUCTS

2.01 POWER WIRE

- A. All 600V rated power wire shall consist of stranded, copper conductor with insulation type XHHW-2, 90C
- B. Circuits within the interior spaces of buildings may utilize 600V rated insulation, type THHN/THWN, 75C.

- C. Conductors shall be stranded copper per ASTM-B8, B-33 and B-189, Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be 12AWG.
- D. 600V rated individual or multi-conductor power wire and cable shall be manufactured by the Okonite Company, BICC Industrial Cable Company or Approved.

2.02 CONTROL WIRE

- A. All 600V rated control wire shall consist of stranded, copper conductor with insulation type THHN/THWN, 75C.
- B. Conductors shall be stranded copper per ASTM B-8, B 33 and B-189, Class B or C stranding contingent on the size unless otherwise specified. Minimum wire size shall be 14AWG.
- C. 600V rated individual or multi-conductor control wire shall be manufactured by the Okonite Company, BICC Industrial Cable Company or Approved.

2.03 LIGHTING AND RECEPTACLE WIRE

- A. All exterior lighting and receptacle branch circuit wire shall consist of stranded, copper conductors with 600V rated insulation, type XHHW-2, 90C.
- B. Interior lighting and receptacle branch circuit wire may utilize stranded, copper conductors with 600V rated insulation, type THHN/THWN 75C.
- C. Conductors shall be stranded copper per ASTM-B8, B-33 and B-189, Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be 12AWG.
- D. Lighting and receptacle wire shall be manufactured by the General Cable Company, Southwire Cable Company or Approved.

2.04 CONTROL SIGNAL CABLE (F/UT)

- A. Control cable for discrete signals shall be unshielded twisted individual conductors (F/UT) or twisted multi-paired conductors with an overall foil shield (F/UTP), unless otherwise noted on the Contract Documents. Conductors shall be tinned, or alloy coated, soft, annealed stranded 14AWG copper with 600V rated insulation for 75C. All twisted pairs shall have an overall foil shield with a 18AWG tinned copper drain wire. Outer jackets shall be lead-free, cross-linked chlorinated polyethylene.
- B. Typical notation as shown on the Contract Documents:

1. 1[9C#14F/UT] denotes one (1) cable of nine (9) twisted 14AWG conductors wrapped within an overall foil shielded outer jacket
- C. The individual conductors of the multi-conductor control cable shall be color coded for proper identification. Color coding shall be equal to ICEA S-68-514, Table K-
 1. Cables shall meet requirements of IEEE-383.
- D. Control cable shall be
 1. Southwire Product Series: 367120 or Approved.

2.05 INSTRUMENTATION SIGNAL CABLE (F/FTP)

- A. Instrumentation cable for analog signals shall be individually shielded twisted paired Conductors (F/FTP) or individually shielded twisted multi-pair conductors within an overall foil shield (F/FTP), unless otherwise shown on the Contract Documents. Conductors shall be tin, or alloy coated, soft, annealed stranded 16AWG copper with 600V rated insulation for 75C. All cable assemblies shall have a 18AWG tinned copper drain wire. Outer jackets shall be lead-free, cross-linked chlorinated polyethylene.
- B. Typical notation as shown on the Contract Documents:
 1. 2[2C#16F/FTP] denotes two (2) cables of two (2) twisted 16AWG paired conductors within individual foil shield and wrapped with an overall foil shielded outer jacket
- C. Instrumentation cable shall be
 1. Southwire Product Series: 337630 or Approved.

2.06 CABLE FITTINGS AND CONNECTORS

- A. Where shown in the Contract Documents, Contractor shall provide and install all required cable glands, fittings and connectors with those manufacturer approvals, UL listing and/or NEMA rating to match enclosures and/or devices to which the cable is terminated.
- B. Where cables are subject to vibration and/or tension, Contractor shall provide and install cable glands, fittings and connectors with strain-relief assembly to include supplemental cable strain-reliefs were required.

PART 3 - EXECUTION

3.01 GENERAL

- A. Power Feeder and Branch Circuitry
 - 1. All power feeder and branch circuit cables, wires and/or conductors shall be terminated in accordance with the applicable Specification Sections throughout all power distribution equipment to include all utilization equipment and/or devices.
 - a. Splices within pull-boxes and junction boxes for all power feeder circuits rated 100A or more are not acceptable unless approved by Engineer.
- B. Control, Signal and Data Circuitries
 - 1. All control, signal and data cables, wires and/or conductors shall be terminated in accordance with the applicable Project Specification Sections throughout all terminal, marshalling cabinets to include all control and/or utilization devices.
 - a. Splices within pull-boxes and junction boxes are not acceptable unless approved by Engineer
 - 2. All control and data cabling routed to Programmable Logic Controllers (PLC) and/or SCADA equipment shall be identified and neatly bound in coils, secured with white nylon cable ties
 - a. Sufficient cable and/or wire slack shall be provided such that no splicing is required within PLC and SCADA cabinets.
- C. Contractor shall ensure all power, control, signal and data cables, wires and/or conductors are terminated correctly throughout the entire circuit and shall provide labor and materials as required to make all corrections necessary without any additional cost to Owner.
- D. Engineer and/or Owner Representative reserves the right to witness and inspect all power, control, signal and data terminations.

3.02 600V CABLE INSTALLATION

- A. Cable and wires shall be installed as specified herein and shown on the Contract Documents.

- B. Cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.
- C. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox-E as manufactured by Burndy Electrical, or approved equal.
- D. Splices are normally not permitted in the underground duct, manhole and handhole systems. If splices are required, Contractor shall obtain approval in writing from the Engineer prior to splicing.
 - 1. Splicing material shall be a two-part insulating and encapsulating resin.
- E. Sizing
 - 1. Sizes of cable and wire shall be as shown in the Contract Documents, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be coordinated with and approved by the Engineer.
 - 2. Minimum wire size within control panels, motor control centers, switchboards and similar equipment shall be 12AWG for power and 14AWG for control.
- F. Quantity
 - 1. The number of wires indicated in the Contract Documents for the various control, indication, and metering circuits were determined for general schemes of control and for particular indication and metering systems.
 - 2. The actual number of wires installed for each circuit shall, in no case, be less than the number required; however, the Contractor shall add as many wires as may be required for control and indication of the actual equipment selected for installation at no additional cost to the Owner. The addition of conductors shall be coordinated with and approved by the Engineer.
- G. Identification
 - 1. Provide and install cable, conductor and wiring identification in accordance with the procedures and requirements Specification Section(s):
 - a. 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS
- H. Installation
 - 1. All interior cable not protected by a compartment enclosure shall be run in conduit.

I. Training

1. Furnish all labor and material required to train wire, conductors and cables in all electrical and control enclosures to include but not limited to cable vaults within buildings, manholes, hand-holes and pull-boxes.
 - a. Sufficient length of cable shall be provided in each cable vault, manhole, handhole or underground pull-box such that the wire, conductors or cable can be trained and racked in an approved manner. In training or racking, the radius of bend of any wire, conductors or cable shall be not less than the manufacturer's recommendation. The training shall be done in such a manner as to minimize chaffing.
 - b. Slack coils of wire, conductors or cables shall be provided in all pull-boxes, junction boxes, etc. and secured with approved UV resistant cable ties.
 - c. Power and control wire, conductors or cables shall be neatly routed, trained and secured with approved UV resistant cable ties within all electrical enclosures to include but not limited to switchboards, transformers, transfer switches, power panels, lighting panels, disconnects, control cabinets such as PLCs.

J. Terminations and Connections

1. Where stranded wires are terminated at panels, and/or devices, connections shall be made by solderless lug, crimp type ferrule or solder dipped.
2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make seven-strand, 12AWG, wire terminations impractical, the Contractor shall terminate external circuits in an adjacent junction box of proper size and shall install 14AWG stranded wires from the device to the junction box in a conduit. The 12 AWG field wiring shall also be terminated in the same junction box to complete the circuit.

K. Temperature

1. Cable shall not be flexed or pulled when the temperature of the insulation or of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature within a three-day period prior to pulling of 40F or lower, cable reels shall be stored during the three-day period prior to pulling in a protected storage area with an ambient temperature not lower than 55F and pulling shall be completed during the work day for which the cable is removed from the protected storage.

L. Color Coding

1. Unless otherwise noted in the Contract Documents, conductor insulation shall be color coded as follows:
 - a. 480V AC Power:
 - 1) Phase A - BROWN
 - 2) Phase B - ORANGE
 - 3) Phase C - YELLOW
 - 4) Neutral – GREY
 - b. 120/208V or 120/240V AC Power:
 - 1) Phase A - BLACK
 - 2) Phase B - RED
 - 3) Phase C - BLUE
 - 4) Neutral – WHITE
 - c. 120VAC Control:
 - 1) Ungrounded conductors – RED
 - 2) Ungrounded conductors, foreign source - YELLOW.
 - d. 24VAC Control:
 - 1) All wiring – ORANGE
 - e. 24VDC Power:
 - 1) Positive Lead – RED
 - 2) Negative Lead – BLACK
 - f. 24VDC Control:
 - 1) Ungrounded conductors – BLUE
 - 2) Grounded conductors – BLUE w/ WHITE stripe
 - g. Equipment Grounding Conductor:
 - 1) All wiring – GREEN
2. Conductors 4AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be coded by the use of colored tape.

3.03 INSTRUMENTATION / TELEPHONE / DATA CABLE INSTALLATION

- A. Grounding of cable shield shall be accomplished at one end point only.
- B. Raceways exceeding 5FT and containing instrumentation / telephone / data cable shall be installed to provide the following clearances:
 - 1. Raceway installed parallel to raceway conductors energized at 480 through 208V shall be 18IN and 208/120V shall be 12IN.
 - 2. Raceway installed at right angles to conductors energized at 480V or 120/208V shall be 6IN.
- C. Where practical, raceways containing instrumentation / telephone / data cable shall cross raceway containing conductors of other systems at right angles.
- D. Where instrumentation / telephone / data cables are installed in panels, etc., the Contractor shall arrange wiring to provide maximum clearance between cables and other conductors. Instrumentation / telephone / data cables shall not be installed in same bundle with conductors of other circuits.
- E. Additional pullboxes shall be furnished and installed for ease of cable pulling and the cable manufacturer's recommended conduit fill factor shall be followed.
- F. All cable, insulation and jacket shall have adequate strength to allow for it to be pulled through the conduit systems. Sufficient conductors shall be installed to provide space and serve future equipment where shown and specified. All conductors shall be color coded and all wires shall be suitably tagged with permanent markers at each end.

3.04 TESTING

- A. All wire and cable testing shall be performed in accordance with the requirements of Specification Section(s):
 - 1. 26 00 10 – TESTING AND COMMISSIONING OF ELECTRICAL SYSTEMS
- B. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner.
- C. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment.

3.05 ATTACHMENTS

A. Schedules

1. Low-Voltage Cable and Raceway Schedule

END OF SECTION

SECTION 26 05 26 – GROUNDING AND BONDING

PART 1 - GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered as a minimum requirement for compliance with this Specification Section.
- B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100-92, Powering and Grounding of Sensitive Electronic Equipment. Conflicts shall be promptly brought to the attention of the Engineer.
- C. In addition to the NEC requirements, building structural steel columns shall be permanently and effectively grounded:
- D. Additional requirements for grounding and bonding as shown on the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this section, the requirements of Division 26 and those Project Specification Sections referenced therein shall be applied.

1.03 REFERENCES

- A. All grounding components and the completed system shall comply with the following codes and standards as well as within the Specifications or as shown in the Contract Documents:
- B. Codes and Standards:
 - 1. American National Standards Institute (ANSI/IEEE):
 - a. C2, National Electrical Safety Code (NEC)
 - 2. Institute of Electrical and Electronic Engineers (IEEE):
 - a. IEEE 81, Guide for Measuring Earth Resistivity.

- b. IEEE 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- 3. National Fire Protection Association (NFPA):
 - a. NFPA 70, National Electric Code (NEC)
- 4. Underwriters Laboratories Inc (UL):
 - a. 588, Grounding Equipment

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per the Contract Specifications
- B. Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Reports of certified field tests. Each submittal shall be identified by the applicable Specification Section.
 - 3. Equipment specifications and product data sheets identifying all materials used and methods of fabrication.
- C. Contractor shall provide drawings and written description(s) of how the grounding/bonding system will be installed for Engineer review prior to commencing work.

1.05 DELIVERY, STORAGE AND HANDLING - NOT USED

1.06 OPERATION AND MAINTENANCE MANUALS - NOT USED

1.07 WARRANTY - NOT USED

1.08 IDENTIFICATION - NOT USED

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Contract Documents.

2.02 EQUIPMENT GROUND CONDUCTOR

- A. A green, insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. Equipment grounding conductors shall be furnished and installed in all conduits.

2.03 GROUNDING ELECTRODE CONDUCTOR

- A. Grounding electrode conductor shall be tin-plated bare copper, sized per NEC or as shown on drawings. Ground conductors shall be continuous from a connection at earth to all distribution panelboards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner. Use of conduits as the NEC required equipment grounding conductor is not acceptable.
- B. Where specified or shown a 3IN strap shall be furnished and installed as the grounding conductor collector.

2.04 BONDING CONDUCTOR

- A. A green, tin-plated, insulated bonding conductor, which shall be separate from the electrical system equipment ground conductor, shall be furnished and installed for bonding metal enclosures to ground. Terminations shall be compression lug.

2.05 BONDING FITTINGS

- A. Grounding connections to equipment shall be bolted. Cable end connections may be made by use of the crucible weld process or bolted type connectors. Bolted type connectors for this application shall consist of corrosion resistant copper alloy with silicone bronze bolts, nuts and lock-washers which are designed for this purpose.

2.06 GROUND RODS

- A. Ground rods shall be rolled to a commercially round shape from copper clad steel manufactured by the molten welding process or by the electro formed process (molecularly bonded). They shall have an ultimate tensile strength of 75kPSI and an elastic limit of 49kPSI. The rods shall be not less than 3/4IN diameter by 10FT in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.013IN at any point on the rod.
- B. The maximum resistance to ground of a single driven ground rod shall not exceed 25 OHM under normally dry conditions. Where the resistance obtained with one (1) ground rod exceeds 25 OHM, additional ground rods shall be coupled, by

exothermic welds. Except where specifically indicated otherwise, all exposed non-current carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in non-metallic raceways and neutral conductors of wiring systems shall be grounded.

- C. The ground connection shall be made at the main service equipment and shall be extended to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection. If there is not suitable metallic water service to the facility, the ground connection shall be made to the driven ground rods on the exterior of the building.
- D. Where ground fault protection is employed, care shall be taken so that the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

2.07 GROUNDING GRID

- A. A grounding grid shall be provided for each structure and interconnected between structures. The grounding grid shall be installed such that the ground resistance does not exceed 5 OHM. The grounding grid shall be interconnected by tin-plated bare copper conductors sized to the largest service entrance ground. When spliced, or connected to ground rods, connection shall be by exothermic welds (Cad-Weld). The grounding conductors shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtailes" shall be exothermically connected to the grounding grid system and shall enter the buildings and structure from the outside. Grid shall be connected to steel and rebar structures using bolted or welded connections, and equipment as described in this Section and as shown in the Contract Documents.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.
- B. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.
- C. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in PVC SCH-80 raceway.

- D. Mechanical connections shall be permitted to ground rods in “Ground Test Wells” and shall be exposed to permit maintenance and inspection for continuity and effectiveness of grounding system.
- E. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.
- F. Conduit:
 - 1. Conduit that enters equipment such as motor control centers, switchboards, switchgear, variable frequency drives, instrument and control panels, and similar equipment shall be bonded to the ground bus, where provided, and as otherwise required by the NEC.

3.02 TESTING

- A. All testing shall be performed in accordance with the requirements of Specification Section(s):
 - 1. 26 00 10 – TESTING AND COMMISSIONING OF ELECTRICAL SYSTEMS
- B. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner.
- C. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment.
- D. Field Tests:
 - 1. Ground resistance shall be measured with a three-point, fall of potential instrument.
 - 2. All ground rods shall be tested after being driven and prior to connection to the grounding system. Where test results show resistance-to-ground is greater-than 25OHM, additional ground rods shall be driven by coupling with exothermic welds. The compliance shall be demonstrated by retesting ground rod.
 - 3. Upon completion of installation of the grounding and bonding system, the entire system shall be tested at the ground test well(s), as indicated in the Contract Documents. The completed system shall have less-than 5OHM of ground resistance.

END OF SECTION

SECTION 26 05 29 – ELECTRICAL HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish, install and place in satisfactory condition all conduit, cable-tray, raceway and equipment hangers and/or supports as required for proper installation of those systems per equipment manufacturer installation instructions and applicable codes and standards. All hardware and fasteners required for the installation shall be furnished and installed by the Contractor.
- B. All support structures and mounting for panels, cable tray, conduit, or lighting shall be approved by a Florida Structural PE supplied by the contractor. Any redesign costs for support structure or wind loading shall be borne by the contractor.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this section, the requirements of Division 26 and those Project Specification Sections referenced therein shall be applied.

1.03 REFERENCES

- A. Abbreviations and Acronyms:
 - 1. American Society for Testing and Materials (ASTM)
 - 2. National Electric Code (NEC)
 - 3. National Electric Manufacturers Association (NEMA)
 - 4. National Fire Protection Agency (NFPA)
 - 5. Nationally Recognized Testing Laboratories (NRTL)
 - 6. Polyvinyl Chloride (PVC)
 - 7. Underwriters Laboratories, Inc. (UL)
- B. Codes and Standards:
 - 1. ASTM A1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
 - 2. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials
 - 3. ASTM F1136 – Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners

4. ASTM A1018 – Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
 5. ASTM B633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
 6. NEMA Standards Publication VE-2 – Cable Tray Installation Guidelines
 7. NFPA 70 – National Electrical Code
- C. Qualifications:
1. Electrical components shall be listed and labeled by UL, CSA or other NRTL testing and listing agencies that provide third-party certification follow-up services.
- D. Strut-Channel and fittings shall have a unique identifying number that trace the product back to material test reports. Stainless steel items shall have a part number that contains a material designator or a separate stamp that includes a reference to the type of material used.

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per the Contract Specifications.
- B. Product data shall be submitted for each support system component and accessory; including clamps, brackets, hanger rods and fittings. The information shall include, but not be limited to, types, materials, finishes, gauge thickness and mounting-hole patterns.

1.05 DELIVERY, STORAGE AND HANDLING - NOT USED

1.06 OPERATION AND MAINTENANCE MAUNALS - NOT USED

1.07 WARRANTY - NOT USED

1.08 IDENTIFICATION - NOT USED

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Acceptable manufacturers:
 1. Allied Power-Strut Products
 2. B Line Systems

3. Rob-Roy Industries
 4. Thomas & Betts
 5. Unistrut Building Systems
- B. All strut, clamps, fittings and fastener materials shall conform to the following unless otherwise noted on the Contract Documents.
1. Indoor/Wet Areas: Aluminum 6063-T6
 2. Indoor/Corrosive Areas: Fiberglass (ASTM D-4385)
 3. Outdoor/Wet Areas:
 - a. Stainless Steel Type-31604 (ASTM A240)
 - b. Aluminum 6063-T6
 4. Outdoor/Corrosive Areas:
 - a. Stainless Steel Type-316 (ASTM A240)
- C. Strut-Channel shall not be bent, drilled, cut or otherwise modified to produce fittings, braces or brackets for conduit and equipment supports.
- D. Manufactured strut-channel braces, brackets, fittings and post-bases shall be provided and installed with associated hardware and fasteners as a complete system for conduit and equipment supports.

2.02 COMPONENTS

- A. Materials:
1. Strut-Channel systems shall be furnished with fittings and accessories designed for use with the manufacturers strut system and made by the same manufacturer.
 2. Contractor shall furnish all necessary locknuts, bushings, pipe clamps, ground clamps, supports, pull boxes, mounting bolts, inserts, lugs and any other materials necessary and proper in the execution of the work.
 3. All fasteners and hardware materials shall be:
 - a. Stainless-Steel Type 316 (ASTM A276).
 4. Anti-Vibratory type fasteners and hardware shall be utilized on all equipment subject to movement and/or vibration or as indicated on the Contract Documents.
 5. Hanger rods shall be that as listed in Section 2.2A.3 or as noted in the Contract Documents and 3/8IN minimum diameter for conduit supports and 1/2IN minimum for cable tray supports.

6. Material types other than those listed in Section 2.2A.3, are not acceptable and considered rejected work by the Engineer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Systems Integration

1. Contractor shall coordinate with other trades and craft to ensure electrical, plumbing and HVAC systems utilize common support and hanger systems to minimize individual support systems for each trade.
 - a. Hanger and support installed for multiple systems shall be designed and installed in accordance with the loading requirements.
 - b. Multiple individual support and hanger systems installed within common areas and spaces for electrical, plumbing and HVAC systems are not acceptable and considered rejected work by Engineer.

B. General

1. Boxes, wall brackets, cabinets and hangers shall be secured by means of toggle bolts in hollow masonry and gyp-board, preset inserts or expansion bolts in solid masonry and concrete, machine screws or bolts on metal surfaces and wood or sheet metal screws in wood construction. Brackets and hangers may also be welded to metal surfaces. Boxes and cabinets shall not be welded to metal surfaces.
2. Electrical cabinets, panelboards, transformers, boxes, disconnect switches, etc., and their supporting hardware, shall be fastened securely to the building structure, bolted strut or fabricated structure.
3. Metal strut shall be installed for surface-mounted cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers and any other electrical devices.
 - a. Fiberglass materials where indicated in the Contract Documents
4. In open overhead spaces, cast boxes threaded to raceways need not be supported separately, except where used for fixture support. Sheet metal boxes shall be supported directly from the building structure.
5. Hanger rods shall be fastened to structural steel members with heavy duty beam clamps. Under concrete floors, rods shall be fastened to concrete inserts set flush to the surface. When a hanger is required with no structural steel member directly above, the Contractor shall span between steel members with strut-channel and attach the rod to the strut.

6. Raceway supports shall be selected and installed in accordance with the manufacturer's recommendations. Raceways shall be supported within 1FT of an unsupported box or fitting. Individual horizontal raceways shall be supported with separate conduit hangers. Horizontal conduit racks shall be trapeze-type hangers utilizing strut and all-thread hanger rods. Each conduit on the rack shall be clamped with conduit clamps designed for use with strut. Trapeze hangers shall be used for all RAC, PVC-RAC and PVC conduits. In vertical applications, raceways shall be supported so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the raceway supports, with no load on the raceway fittings. Vertical conduit racks shall utilize strut attached to walls with conduits attached with pipe clamps.
7. Vertical conductor supports, and conductors shall be installed simultaneously.
8. Conduits, fittings, enclosures, conduit straps and clamps shall not be welded.
9. Supporting devices and raceways shall be installed plumb, horizontal, or parallel to building lines, finished floors and each other.
10. Cable tray supports shall conform to NEMA Standards Publication VE-2, and the cable tray support detail drawings.
11. All electrical equipment shall not be mounted or supported in any manner to hand-rails, stair-wells, ladder-wells, or safety railing systems unless approved by structural Engineer of record
12. Residential and/or Commercial supports and hanger methods and materials are not acceptable and considered rejected work by Engineer. Example: plumber's perforated strap, "caddy" clips, "push-in" conduit fittings, etc.

END OF SECTION

SECTION 26 05 30.10 – ELECTRICAL CABLE INSTALLATION IN RACEWAY SYSTEMS

PART 1 - GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish all labor, materials, tools and equipment necessary for installing medium-voltage and low-voltage cables, conductors, wires, etc. in those associative raceway systems as indicated on the Contract Documents and as required under the Project Scope Of Work (SOW).
- B. Contractor shall handle and store medium-voltage and low-voltage cables, conductors, wires, etc. as specified herein.
- C. Contractor shall provide cable pull installation plan(s) along with cable pull calculations for each pull as specified herein and indicated on the Contract Documents.
- D. Calculations include but not limited to the following:
 - 1. Pulling Tension
 - 2. Sidewall Pressure
 - 3. Jam Ratio
 - 4. Bending Radius

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this section, the requirements of Division 26 and those Project Documents referenced herein shall be applied.
- B. Related Specification Section(s) include but not limited to:
 - 1. 26 05 19 – LOW-VOLTAGE CONDUCTORS AND CABLES
 - 2. 26 05 33.13 – ELECTRICAL RACEWAY SYSTEMS
 - 3. 26 05 33.16 – BOXES, CABINETS AND ENCLOSURES FOR ELECTRICAL SYSTEMS
 - 4. 26 05 36 – CABLE TRAYS FOR ELECTRICAL SYSTEMS
 - 5. 26 05 43 – UNDERGROUND DUCTBANKS FOR ELECTRICAL SYSTEMS

1.02 REFERENCES

- A. Codes and Standards

1. Association of Edison Illuminating Companies (AEIC)
 - a. G5-90 – Underground Extruded Power Cable Pulling Guide
2. Electric Power Research Institute (EPRI)
 - a. EL3333 – Maximum Safe Pulling Lengths for Solid Dielectric Insulated Cables
3. Institute of Electrical and Electronic Engineers (IEEE)
 - a. 576 – Recommended practice for installation, termination, and testing of insulated power cable as used in industrial and commercial applications
 - b. 1185 – Recommended Practice for Cable Installation in Generating Stations and Industrial Facilities
4. National Fire Protection Association (NFPA)
 - a. 70, National Electrical Code

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per the Contract Specification.
- B. Cable Pull Installation Plans
 1. Proposed cable routing sketches through duct-bank systems to include associated man-holes, pull-boxes, etc. with a detailed description of the proposed cable pulling procedures.
 2. Proposed cable pulling equipment list to include but not limited to manufacturer, model/part-number, date purchased, calibration date, etc.
 - a. Equipment other than that designed and manufactured for cable pulling is prohibited by the Engineer.
 3. Provide cable sizes and lengths for each pull along with personnel list indicating foreman with responsible charge and support personnel.
- C. Cable Pull Calculations
 1. Provide legible hand calculations as required in PART 3 in this Section.
 2. Provide cable pull calculation(s) for each Cable Pull Installation Plan.

1.05 DELIVERY, STORAGE AND HANDLING

A. Contractor shall reference those requirements provided in Specification Section(s)

1. 26 05 19 – LOW-VOLTAGE CONDUCTORS AND CABLES

OPERATION AND MAINTENANCE MANUALS – NOT USED

1.07 WARRANTY

A. NOT USED

1.08 IDENTIFICATION

A. All electrical power and control conductors shall be identified with the appropriate identification tag number(s) as indicated on the Contract Documents and the approved submittal(s) as required per Specification Section(s)

1. 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials covered by under this Section are intended to be standard of proven performance and as manufactured by reputable firms.

2.02 CABLE PULLING LUBRICANTS

A. All cable pulling lubricants and residue shall be UL listed, non-flammable and contain no waxes or greases.

B. All cable pulling lubricants shall no deleterious effects on the raceway or cable insulation.

C. The following manufacturers and commercial lubricants listed herein are recommended for easing pulling tensions and are acceptable if and only if approved by the cable manufacturer.

D. Acceptable Manufacturers

1. American Polywater Corporation
 - a. Polywater Lubricant "J"
2. Ideal Industries, Inc.

- a. Yellow 77 Plus Wire Pulling Lubricant
 - b. Aqua-Gel II Cable Pulling Lubricant
3. Greenlee Textron, Inc.
- a. Cable Cream Pulling Lubricant
 - b. Cable Gel Pulling Lubricant
 - c. Fiber-Gel Pulling Lubricant (FO Cables)
4. 3M, Electrical Products Division
- a. WL Wire Pulling Lubricant

PART 3 - EXECUTION

3.01 PREPARATION

- A. Immediately prior to pulling any cable through any underground raceway system, raceways routed through corrosive environments or any above-ground raceway systems that have been installed and in place for more than thirty days (30DY); a wire brush and swab, equal to the raceway inside diameter, shall be pulled through the conduit to remove all obstructions, dirt and debris. A mandrel shall then be pulled through the completed raceway from end to end. The mandrel shall be no less than 4IN in length with an overall diameter 3/8IN less than the raceway. Any blockages found during the mandrel procedure shall be completely removed and the mandrel re-pulled to verify the raceway is clear and serviceable. After the mandrel procedure is completed, a single rope or cord having a minimum breaking strength of 500LBS shall be installed in each raceway to aid in the cable pull installation plan(s).

3.02 CALCULATIONS

- A. Techniques
- 1. Calculations shall be utilized to determine the parameters for cable pulling tolerances.
 - 2. Pulling Tension

Maximum pulling tension may be calculated from the following equation:

$$T_n = s \cdot CM \cdot n$$

where:

T_n = Maximum Conductor Pulling Tension in lbs

$s = 0.006$ (Allowable Conductor Stress)

CM = Circular Mil Area of the Conductor

n = Number of Conductors

3. Straight Raceway Sections

- a. Pulling tension through straight raceways may be calculated from the following equation:

$$T = l \cdot w \cdot f_{d,l} \cdot x_{o,c,t}$$

where:

T = Cable Pulling Tension in lbs

w = Weight of Cable in lbs/ft

l = Length of Straight Conduit in ft

$f_{d,l}$ = Coefficient of Friction

$f_d = 0.75$ (Dry Conduit)

$f_l = 0.50$ (Lubricated Conduit)

$x_{o,c,t}$ = Weight Correction Factor

$$x_o = 1.0 \quad \text{[One Cable]} \quad (3)$$

$$x_c = 1 + \frac{4}{3} \times \left(\frac{d}{D-d}\right)^2 \quad \text{[Three Cables, Cradled]} \quad (4)$$

$$x_t = \frac{1}{\sqrt{\left(1 - \left(\frac{d}{D-d}\right)^2\right)}} \quad \text{[Three Cables, Triangular]} \quad (5)$$

where:

D = Inside Diameter of Conduit in inches

d = Overall Diameter of Conduit in inches

4. Curved Raceway Sections

- a. Pulling tension through curved raceways may be calculated from the following equation:

$$T_{out} = T_{in} \times e^{fa}$$

where:

T_{out} = Cable Pulling Tension in lbs coming out of a bend

T_{in} = Cable Pulling Tension in lbs going into a bend

$e = 2.718$ (Napierian Logarithm Base)

f = Coefficient of Friction

$f_d = 0.75$ (Dry Conduit)

$f_l = 0.50$ (Lubricated Conduit)

α = Angle of Bend Radius in Radians

Values for $e^{f\alpha}$ have been calculated below for typical conduit bends:

Bending Angle (Degrees)	$e^{f\alpha}$ (Dry Conduit)	$e^{f\alpha}$ (Lubricated Conduit)
15	1.22	1.14
30	1.48	1.30
45	1.80	1.48
60	2.19	1.69
75	2.67	1.85
90	3.25	2.20

5. Sidewall Pressure

Sidewall pressure may be calculated from the following equations:

$$P = \frac{T_{out}}{R} \quad \text{[One Cable]}$$

$$P = \frac{(3x_c - 2) \times T_{out}}{3R} \quad \text{[Three Cables, Cradled]}$$

$$P = \frac{x_t \times T_{out}}{2R} \quad \text{[Three Cables, Triangular]}$$

where:

P = Sidewall Pressure in lbs/ft

T_{out} = Cable Pulling Tension in lbs coming out of a bend (Equation 6)

R = Inside Radius of the Conduit Bend in feet

x_c = Weight Correction Factor (Equation 4)

x_t = Weight Correction Factor (Equation 5)

6. Jam Ratio

- a. Jamming ratio may be calculated from the equation:

$$JR = \frac{D}{d}$$

where:

JR = Jamming Ratio of three single conductor cables with equal diameter

D = Inside Diameter of Conduit in inches

d = Overall Diameter of Conduit in inches

B. Tolerances

1. Pulling Tension

- a. Individual Conductors

- 1) Under no circumstances shall the total individual conductor pulling tension exceed the maximum tension (*T_n*) calculated in Equation 1. Individual conductor pulling tension through a bend shall not exceed forty-times the radius of the bend (expressed in inches). If a pulling eye is utilized, individual conductor pulling tension shall not exceed 6,000LBS. If a basket grip is utilized, individual conductor pulling tension shall not exceed 1,000LBS.

- b. Multiple Conductors

- 1) When three (3) or more individual conductors of equal size are pulled together, the pulling tension shall under no circumstances exceed 60% of the maximum tension (*T_n*) calculated in Equation 1. (Calculations involving three (3) or more individual conductors of different sizes shall be performed under engineering supervision.) If a pulling eye is utilized, multi-conductor pulling tension shall not exceed 10,000LBS. If a basket grip is utilized, multi-conductor pulling tension shall not exceed 1,000LBS.

2. Sidewall Pressure

- a. The side wall pressures (*P*) calculated in Equations 7, 8 & 9 shall under no circumstances exceed three hundred-times the radius of the bend (expressed in feet).
- b. Power Cables

- 1) Side wall pressure for a single power cable smaller than #8AWG shall not exceed 300LBS/FT. Side wall pressure for a single power cable greater than #8AWG shall not exceed 500LBS/FT.
 - 2) Side wall pressures for two (2) or more power cables smaller than #8AWG shall not exceed 500LBS/FT. Side wall pressures for two (2) or more power cables greater than #8AWG shall not exceed 1000LBS/FT.
 - c. Control Cables
 - 1) Side wall pressure for a single control cable shall not exceed 500LBS/FT. Side wall pressures for two (2) or more control cables shall not exceed 1000LBS/FT.
 - d. Instrumentation Cables
 - 1) Side wall pressure for a single instrumentation cable shall not exceed 300LBS/FT. Side wall pressures for two (2) or more instrumentation cables shall not exceed 1000LBS/FT.
3. Jam Ratio
- a. The cable jamming ratio (JR) calculated in Equation 10 may be used as an indication of the likelihood of cables jamming during the installation process. The probability of cable jamming increases between values of 2.4 through 3.2 and rises significantly between values 2.6 through 2.9.
4. Bending Radius:
- a. The bending radius of all cables shall be maximized to prevent physical damage to the jacket and insulation. The minimum bending radius shall be eight-times the overall cable diameter for non-shielded conductors and twelve-times the overall cable diameter for shielded conductors. The minimum bending radius for multi-conductor shielded power cables or triplexed single conductor shielded power cables shall not exceed twelve-times the diameter of the individually shielded conductor or seven times the overall cable diameter, whichever is greater. These minimum requirements do not supersede the minimum bending radii that may be required to alleviate pulling tensions and sidewall pressures during cable installation.

3.03 INSTALLATION

- A. Low-Voltage and Medium-Voltage cables, conductors, wires, etc. shall be installed in those raceways as indicated on the Contract Documents and in accordance with NFPA 70. Contractor shall utilize pulling equipment approved by the cable manufacturer and in good working condition.

- B. Systems Integration
 - 1. The minimum ambient temperature at which cables may be installed without special precautions is 14F. If the ambient temperature is below 14F, the following precautions shall be taken prior to cable installation:
 - a. Cables shall be stored indoors for at least three days (3DY).
 - b. The indoor storage temperature shall be at least 65F.
 - c. Cables shall be installed and trained in place the same day they are removed from indoor storage.
 - 2. Cable reels shall be set up for pulling and located such that during installation, the cable will not be subjected to reverse bends or bends less than twice the minimum cable bending radius.
 - 3. Cable pulling points indicating the direction the cable is to be pulled shall be shown on the submitted Cable Pull Installation Plan(s); reference Section 1.4B.
 - 4. A snatch block with a pulley diameter of at least twice the minimum bending cable radius, a flexible tube or a cable pulling protector shall be utilized for protection of the cable during installation and to help guide the cable into the raceway.
 - 5. Cable pulling rope shall be polypropylene or a double-braided composite rope with a diameter of at least 1/2IN and a 4:1 safety factor.
 - 6. Pulling eyes shall be utilized and attached securely to the cable so there is no risk of disengagement during installation. Sharp projections of the eye, swivel and cable attachment assembly shall be covered and protected to prevent conduit damage. In heavier cable installations, it may be necessary to use a grip over the outer covering in addition to the conductor connection to prevent slippage. The tension applied to the pulling eye shall not exceed 10,000LBS or the manufacturer's allowable tension.
 - 7. If powered pulling devices are utilized, the device shall have adequate power to pull the cables steadily without jerking. The rate of pull shall not exceed 50FT/MIN.
 - 8. Upon Engineer and/or Owner request, Contractor shall furnish and install a dynamometer to observe the cable pulling tension during installation.
 - 9. Lubrication shall be applied as needed to ensure the cable pulling tolerances are satisfied. The outer cable jacket and/or raceway walls shall be completely lubricated before and during the installation as needed. The quantity of lubrication utilized should be maximized for "difficult" pulls.

10. Contractor shall submit detailed Cable Pull Installation Plan(s) along with applicable Cable Pull Calculations; reference Sections 1.4B, C for Engineer approval, prior to pulling cable(s) through more than one (1) man-hole, vault, pull box, etc.
11. Cables pulled through man-holes, vaults, pull-boxes, etc. shall have adequate slack left in the manhole to prevent possible creepage and for training the cable to its final position. Strain on the cable shall not occur at any point. Sheaves with an adequate bending radius shall be utilized to prevent cable damage when changing directions through a man-hole, vault, pull-box, etc.
12. Precautions shall be taken to ensure no cable is pulled directly around right-angle bends in man-holes, vaults, pull-boxes, etc.
13. Cables shall be continuous from termination point to termination point. Cables shall not be spliced unless indicated on the raceway plans and details.
14. Cables pulled to boxes, trays, panels or any other location they are not immediately terminated shall be coiled after pulling to prevent damage from bending due to their own weight. No bend in the coiled cable shall be smaller than the minimum bending radius of the cable. The weight of the coiled cable shall be supported from the box, tray, panel or by means of temporary ropes or plastic cable ties. Under no circumstances shall the coiled cable hang from the cable itself.
15. Cables pulled to outdoor locations shall be capped and sealed immediately after installation.

END OF SECTION

SECTION 26 05 33.13 – ELECTRICAL RACEWAY SYSTEMS

PART 1 - GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish all labor, materials, tools, and equipment necessary for furnishing, installing, connecting, testing, and placing into service all raceway systems to include all conduits, conduit fittings, wireway, supports, etc. as required for a complete electric installation as specified herein and indicated on the Contract Documents.
- B. Conduit home runs for lighting, receptacle, instrumentation, and other miscellaneous circuits are not necessarily depicted on the Contract Documents; however, the circuit numbers are shown. Conduit shall be furnished and installed for these circuits.
- C. Additional conduit and raceway from what are shown on the Contract Documents may be required. Contractor shall coordinate with the requirements of equipment provided under other Divisions.
- D. Refer to sheet E0.01 for use of conduit type at various locations.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this section, the requirements of Division 26 and those Project Documents referenced herein shall be applied.
- B. Related Specification Sections include but not limited to:
 - 1. Division 02 – SITEWORK
 - 2. 26 05 19 – LOW VOLTAGE CONDUCTORS AND CABLES
 - 3. 26 05 29 – ELECTRICAL HANGERS AND SUPPORTS
 - 4. 26 05 33.16 – BOXES, CABINETS AND ENCLOSURES FOR ELECTRICAL SYSTEMS

1.03 REFERENCES

- A. Raceways shall comply with the following applicable codes and standards as well as any others within the specifications and Contract Documents. In the event of any conflict between these codes, regulations, standards, and Contract Documents, the most restrictive shall apply.
- B. Codes and Standards

1. American National Standards Institute (ANSI)
 - a. C80.1, Rigid Steel Conduit Zinc Coated.
 - b. C80.3, Electrical Metallic Tubing Zinc Coated.
 - c. C80.4 Fittings for Rigid Metal Conduit and Electrical Metallic Tubing.
 - d. C80.5 Electrical Rigid Aluminum Conduit.
 - e. C80.6 Electrical Intermediate Metal Conduit.

2. American Society for Testing and Materials (ASTM)
 - a. A36, Standard Specification for Structural Steel.
 - b. A153, Zinc Coating (Hot Dip) on Iron and Steel Hardware.
 - c. A307, Carbon Steel Externally Threaded Standard Fasteners.
 - d. A563, Standard Specification for Carbon Steel Nuts.
 - e. A569, Steel Carbon, Hot Rolled Sheet and Strip, Commercial Quality.
 - f. A570, Hot Rolled Sheet and Strip, Structural Quality.
 - g. A575, Merchant Quality Hot Rolled Carbon Steel Bars.
 - h. A635, Standard Specification for Steel, Sheet and Strip, Heavy Thickness Coils, Carbon, Hot Rolled.
 - i. D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - j. D1788, Standard Specification for Rigid Acrylonitrile Butadiene Styrene (ABS) Plastics.
 - k. D2564, Solvent Cements for (PVC) Plastic Pipe, Tubing, and Fittings.
 - l. F512, Standard Specification for Smooth Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation.

3. ETL Testing Laboratories, Inc (ETL)
4. National Electric Manufacturers Association (NEMA)
 - a. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - b. TC 2, Electrical Plastic Tubing (EPT) and Conduit (EPC 40 and EPC 80).
 - c. TC 6, PVC and ABS Plastic Utilities Duct for Underground Installation.

5. National Electric Contractors Association (NECA)
 - a. NECA 1: Standard Practices for Good Workmanship in Electrical Construction.
 - b. Project applicable standards and recommendations

6. National Electric Installation Standards (NEIS)
 - a. Project applicable standards and recommendations
7. National Fire Protection Association (NFPA)
 - a. 70, National Electric Code (NEC).
 - b. 79, Electrical Standard for Industrial Machinery
8. Underwriters Laboratories Inc (UL)
 - a. 1, Flexible Metal Conduit.
 - b. 6, Rigid Metal Conduit.
 - c. 6A, Electrical Rigid Metal Conduit – Aluminum.
 - d. 209, Cellular Metal Floor Raceways and Fittings.
 - e. 360, Liquid Tight Flexible Steel Conduit.
 - f. 467, Grounding and Bonding Equipment.
 - g. 514, Nonmetallic Outlet Boxes, Flush Device Boxes, and Covers.
 - h. 514B, Conduit, Tubing and Cable Fittings.
 - i. 651, Schedule 40 and 80 Rigid PVC Conduit.
 - j. 797, Electrical Metallic Tubing.
 - k. 870, Wireways, Auxiliary Gutters, and Associated Fittings.
 - l. 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
 - m. 1242, Intermediate Metal Conduit.
 - n. 1660, Liquid-Tight Flexible Non-Metallic Conduit.

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per the Contract Specifications.
- B. Construction Drawings
 1. Proposed routing of all site conduits including direct buried, concrete encased, and long run above ground conduits.
 2. Proposed routing of conduits buried under floor slabs.
 3. Proposed routing and details of construction, including conduit and rebar, of conduits embedded in floor slabs, columns, etc.

1.05 DELIVERY, STORAGE AND HANDLING

- A. All raceways, fittings and associated components shall be handled and stored in accordance with manufacturer's instructions and recommendations.

- B. Inspect and report concealed damage to carrier within their required time period. Owner is not responsible for damages incurred during shipping, handling and storage.
- C. Store in a clean, dry space. an additional heavy canvas or heavy plastic cover to protect structure from dirt, water, construction debris, and traffic. Where applicable, provide adequate heating within enclosures to prevent condensation.

1.06 OPERATION AND MAINTENANCE - NOT USED

1.07 WARRANTY - NOT USED

1.08 IDENTIFICATION

- A. All electrical raceway systems shall be identified with the equipment tag number indicated on the Contract Documents and the accepted shop drawings. Nameplates shall be furnished and installed as required Specification Section(s):
- B. 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 2 - PRODUCTS

2.01 GENERAL

- A. Materials covered by under this Section is intended to be standard material of proven performance as manufactured by reputable firms. Raceways and appurtenances shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Contract Documents.
- B. All equipment shall be UL listed and labeled for its intended service.
- C. Subject to compliance with the Contract Documents, the listed manufacturers are acceptable.

2.02 RIGID ALUMINUM CONDUIT (RAC)

- A. Acceptable Manufacturers
 - 1. Allied Tube and Conduit Corporation
 - 2. Western Tube and Conduit Corporation
 - 3. Wheatland Tube Company
- B. RAC and associated fittings shall be manufactured from 6063 aluminum alloy in temper designation T-1.

C. Standards

1. ANSI C80.5

D. Uses:

1. Exposed indoor or outdoor in non-corrosive areas

2.03 PVC COATED RIGID ALUMINUM CONDUIT (PVC-RAC)

A. Acceptable Manufacturers:

1. Thomas & Betts
2. Perma-Cote
3. Rob Roy Ind.

B. PVC-RAC shall have a minimum 40MIL polyvinyl chloride exterior coating. The coating shall be bonded to rigid aluminum conduit conforming to ANSI C80.1. The bond between the polyvinyl chloride coating and the conduit surface shall be greater than the tensile strength of the coating. PVC-RAC shall have a nominal 2MIL, minimum, urethane interior coating and a urethane coating on threads. RAC conduit: shall have an epoxy prime coating prior to application of polyvinyl chloride and urethane coatings.

C. Female ends shall have a plastic sleeve extending a minimum of 1 pipe diameter or 2IN, whichever is less beyond the opening. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used with it.

D. Standards:

1. ANSI C80.1
2. NEMA RN 1

E. Uses:

1. Exposed indoor or outdoor corrosive areas.
2. Concrete wall, slab or curb penetrations.
3. Concrete Ductbanks

2.04 RIGID POLYVINYL CHLORIDE CONDUIT (PVC)

A. Acceptable Manufacturers:

1. Allied Tube and Conduit Corporation
2. Carlon
3. Cantex

- B. PVC shall be either Schedule-40 or Schedule-80. The polyvinyl chloride plastic compound shall meet, as a minimum, ASTM D1784 cell classification PVC 12233 A, B, or C. PVC shall be rated for direct sunlight exposure, 90C wire, and fire retardant with low smoke emission.
- C. Expansion Fittings – Provide expansion fitting on exposed conduit runs in excess of 100 feet.
- D. Standards:
 - 1. ANSI C33.91
 - 2. NEMA TC 2
 - 3. UL 651
- E. Uses:
 - 1. Schedule 40 in concrete ductbanks only.
 - 2. Schedule 80 direct buried
 - 3. Schedule 80 Exposed in Corrosive Atmospheres

2.05 LIQUID-TIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Acceptable Manufacturers:
 - 1. Anamet, Inc.
 - 2. Electri Flex Company
 - 3. International Metal Hose Company
- B. LFMC shall have a core formed of continuous, spiral wound, aluminum strip with successive convolutions securely interlocked, contain an interwoven copper strip suitable as a grounding means, and have an extruded vapor and liquid tight polyvinyl chloride outer jacket positively locked to the steel core.
- C. Standard:
 - 1. UL 360

2.06 WIREWAY

- A. Acceptable Manufacturers:
 - 1. E.M. Wiegmann and Company, Inc.
 - 2. Hoffman Engineering Company
 - 3. Stahlin
 - 4. Square D

- B. Wireway shall have a minimum wall thickness of 0.040IN, be furnished without knockouts, be designed for continuous grounding, and suitable for lay in conductors. Provide Solid and non-removable covers when passing through partitions and solid hinged covers with captive screw fasteners when accessible.
- C. Wireway shall not be smaller than 4 x 4IN unless otherwise indicated on the Contract Documents.
- D. Types
 - 1. NEMA-3/3R/12: Wireway shall be steel, finished with rust inhibiting phosphatizing coating and gray baked enamel finish on interior and exterior surfaces. Cover shall be fully gasketed and provided with captive clamp type latches.
 - 2. NEMA- 4/4X: Wireway shall be type 304 stainless steel for interior or exterior corrosive areas. Cover shall be fully gasketed and provided with captive external screw type clamps.
- E. Standards
 - 1. NFPA 79
 - 2. UL 870

2.07 CONDUIT FITTINGS AND ACCESSORIES

- A. Acceptable Manufacturers:
 - 1. Appleton
 - 2. Carlon
 - 3. Crouse Hinds
 - 4. Killark
 - 5. OZ Gedney Company
 - 6. Perma Cote
 - 7. RACO
 - 8. Rob Roy Ind.
 - 9. Steel City
 - 10. Thomas and Betts
 - 11. Western Plastics Company
- B. Fittings for Use with RAC
 - 1. Materials: Following minimum requirements unless otherwise noted.
 - a. Body: Copper-free aluminum with aluminum lacquer or aluminum enamel finish
 - b. Covers: Copper-free aluminum and gasketed

- c. Gaskets: Neoprene or PVC
 - d. Insulators phenolic, thermosetting: minimum 105C UL rating
 - e. Grounding saddles tin plated copper or bronze suitable for use with copper and aluminum conductors
 - f. Bonding jumpers: Tinned copper flexible braid
 - g. Locknuts: Malleable iron, zinc plated
- 2. All fittings: Threaded unless otherwise noted
- 3. Conduit Hubs shall be cast aluminum with insulated throat or grounding type with insulated throat
- 4. Straight couplings: Same material and finish as the conduit with which they are used
- 5. Mogul pulling elbows and tees:
 - a. Die cast copper free aluminum
 - b. Rain tight
- 6. Conduit seals
 - a. Drain and breather: Stainless steel or brass
 - b. Fiber and sealing compound: UL listed for use with the sealing fitting
- 7. Standards
 - a. UL 467
 - b. UL 514B
- C. Fittings for Use with PVC-RAC
 - 1. The same material and construction as those fittings listed under paragraph "Fittings for Use with RAC"; and coated as defined under paragraph "PVC-RAC."
- D. Fittings for Use with PVC
 - 1. Fittings shall be of the same material, thickness, and construction as the conduits with which they are used.
 - a. Standards:
 - 1) UL 651
 - 2) NEMA TC 2 1978
 - 2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.

- a. Shall be heavy-body, grey
- b. Shall not be more than one (1) year past date of manufacture.
- c. Standard: ASTM D2564

E. Conduit Bodies

- 1. Conduit Bodies shall be of the same material as the conduits with which they are used and sized in accordance with the conductors installed and in compliance with applicable NEC Articles.

- a. Standards:

- 1) UL 514B

F. Fittings for Use with LFMC

- 1. Fittings shall meet the following minimum requirements unless otherwise noted:
 - a. Body: Copper-Free Aluminum
 - b. Ferrule: Aluminum
 - c. Locknuts and compression nuts: Malleable iron, zinc plated
 - d. Sealing ring: Neoprene
- 2. Fittings shall be compression type
- 3. Standard: UL 514
- 4. Where LFMC is subject to vibration and/or tension, Contractor shall provide and install LFMC fittings strain-relief with stainless-steel wire mesh assembly as required.

2.08 HANGERS AND SUPPORTS

- A. See Specification Section 26 05 29 – ELECTRICAL HANGERS AND SUPPORTS

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

- A. All conduit, raceway, wireway and associated fittings shall be stored in accordance with the manufacturer recommendations and shall not be stored exposed to sunlight or other UV radiation.

3.02 INSTALLATION

- A. Contractor shall plan the layout of conduit and raceway systems so that when the work is complete it will exhibit good workmanship practices in accordance with NECA-1.
 - 1. Exposed raceway groupings three (3) or more shall use a common support/hanger system with standard radius bends and be arranged such that no cross-overs and saddle bending is required.
 - 2. Exposed raceway groupings twenty (20) or more shall use a common support/hanger system with concentric radii bends and be arranged such that no cross-overs and saddle bending is required.
 - 3. Exposed raceways and raceway systems that are not organized and grouped in a logical manner are considered rejected work by the Engineer.

- B. Exposed Work
 - 1. Wherever practical all conduit and raceway for power and control circuitry designated for process related equipment shall be installed exposed.

- C. Concealed Work
 - 1. All conduit and raceway for power and control circuitry designated for non-process related equipment shall be installed concealed within structures and/or buildings.
 - 2. All conduit and raceway for branch, receptacle, lighting and/or ancillary systems shall be installed concealed within structures and/or buildings.

- D. Installation of Conduit and Raceway
 - 1. Conduit and Raceway embedded in concrete slabs shall be installed in the middle third of the slab thickness with at least 2IN concrete cover. Raceways shall be secured to reinforcing steel to prevent sagging or shifting during concrete placement. Raceways shall be spaced laterally to prevent voids in the concrete. Reference installation details as shown in the Contract Documents.
 - 2. Conduit and Raceway runs, where shown in the Contract Documents, indicate the preferred location. Site conditions may affect actual routing. Contractor shall coordinate routing and measurement with other trades and with equipment suppliers.
 - 3. Shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance, and repair.
 - 4. Wherever possible avoid routing conduits and raceways through areas of high ambient temperature or radiant heat.

E. Size of Conduits and Raceways

1. The size of conduit and raceway are normally shown on the Contract Documents. If a size is not shown on the Contract Documents, or if a minimum size is not stated in the Specifications, then the minimum size of conduits and raceways shall be ¾" or larger in accordance with the NEC. ½" conduit is not allowed.
2. Conduits shall not be smaller than 1IN for underground installations and 3/4IN elsewhere, unless otherwise shown on the Contract Documents.

F. Types of Conduits and Raceways

1. Shall be installed as defined in the Contract Documents.
2. As required by NFPA.
3. Flexible Conduit:
 - a. Install as the final conduit to motors, electrically operated valves, primary elements (instrumentation), and electrical equipment that is liable to vibrate.
 - b. Shall not be used as a conduit run:
 - c. Maximum length shall not exceed:
 - 1) 60IN to motors.
 - 2) 48IN to all other equipment.
4. PVC-RAC
 - a. Contractor shall use tools, clamps, dies, equipment, etc. designed specifically for the cutting, bending and threading of PVC-RAC.
 - b. Contractor shall follow the recommendations and methods of the manufacturer for installing PVC-RAC.
 - c. Contractor shall repair small (less than 1IN) nicks and cuts to the outer PVC coating per the manufacturer's instructions. If the damaged area is larger (greater than 1IN), the conduit section shall be replaced.

G. Provide openings in walls, floors, and ceilings for all required raceway penetrations.

1. Sleeves and block outs: Set in masonry walls during erection.
2. Sleeves and block outs: Set in concrete during forming.
 - a. Material: Not harmful to the concrete.
 - b. Not considered to replace structurally the displaced concrete.

H. Conduit Runs

1. All conduits within a structure shall be installed concealed unless otherwise noted on the Contract Documents.
2. Total of Bends in a Conduit Run:
 - a. Less than 270 degrees.
 - b. Provide pull boxes, conduit bodies, condulets, or pulling elbows or tees as needed.
3. Run in straight lines parallel to or at right angles to structural members or building lines.
4. Maintain minimum 2IN separation between all conduits.
5. Maintain minimum 6IN separation between instrumentation and power conduits.
6. Maintain minimum 12IN separation from process, gas, air and water pipes.
7. Conduits and accessories embedded in concrete:
 - a. Shall not be larger in outside diameter than one third the thickness of the slab, column or beam.
 - b. Place conduit and accessories after reinforcing steel has been laid.
 - c. Shall not displace the reinforcement steel.
 - d. Provide a minimum of 1-1/2IN of concrete cover around conduit.
 - e. Do not run against reinforcing steel.
 - f. Provide 2IN minimum of spacing between conduits.
 - g. Install expansion/deflection fittings wherever conduit spans structural or expansion joint.

I. Field Bending of Conduits

1. Utilize tools, equipment, methods, and recommendations by the manufacturer to make all field bends.
2. The internal diameter of conduit shall not be reduced or distorted.

J. Field Cutting and Threading Conduits

1. Utilize tools, equipment, methods, and recommendations by the manufacturer to field cut and thread conduit.
2. All field cut conduit shall be cut perpendicular, smooth and evenly chamfered on the inside.
3. All field threaded conduit shall be wire-brushed, cleaned, and degreased before applying a zinc rich paint.

K. Terminating Conduits

1. NEMA 2/12/12K enclosures:

- a. Top: Double sealing locknuts and insulated or grounding bushings.
- b. Side: Double locknuts and insulated or grounding bushings.
- c. Bottom: Double locknuts and insulated or grounding bushings.

2. NEMA 3/3R/3S/13 enclosures:

- a. Top: Not allowable on new work and considered rejected work by Engineer.
- b. Side: Threaded conduit hubs with insulated throats, threaded grounding conduit hubs with insulated throats or approved cable gland fittings Double sealing locknuts and insulated or grounding bushings.
- c. Bottom: Double locknuts and insulated or grounding bushings.

3. NEMA 4/4X enclosures

- a. Top: Not allowable on new work and considered rejected work by Engineer.
- b. Side: Not allowable on new work and considered rejected work by Engineer.
- c. Bottom: Threaded conduit hubs with insulated throats, threaded grounding conduit hubs with insulated throats or approved cable gland fittings.

L. Conduit Bodies

- 1. Conduit bodies shall be installed such that access to covers are maximized and exceed the intent of "Readily Accessible" as described in NEC Article 100. Contractor shall provide and install those conduit body types/models as required to facilitate this requirement in the installation of the completed raceway system(s).
- 2. Conduit bodies containing conductors #4/0AWG and larger shall be "Mogul" type with domed covers and integral rollers.

M. Conduit Moisture Sealing

- 1. All exposed enclosures located outdoors with conduits routed underground or conduits routed from interior to exterior locations shall have:
 - a. Conduit sealing foam filled within each conduit opening.
 - 1) Polywater P/N FST-205KIT1 or approved equal

N. Conduit Coatings

1. The protective coating of metallic conduits, fittings, and accessories shall be maintained.
 - a. Repair PVC-RAC utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the conduit.
 - 1) The total nominal thickness: 40MIL.
 - b. Repair surfaces that will be inaccessible after installation prior to installation.
2. All metallic raceways installed in direct contact with concrete, masonry or soils shall be:
 - a. PVC-RAC
 - b. Installed with heavy-wall heat-shrink polyolefin tubing.
 - c. Two (2) spiral half-lapped layers of 3M (or approved equal) Type-50 all-weather corrosion protection tape.
 - d. Installed with 40MIL minimum coating of cured coal-tar bitumastic paint.
3. All metallic raceway transitions through concrete, masonry or soils shall be:
 - a. PVC-RAC
 - b. Installed with heavy-wall heat-shrink polyolefin tubing extending 6IN minimum on each side of transition.
 - c. Two (2) spiral half-lapped layers of 3M (or approved equal) Type-50 all-weather corrosion protection tape extending 6IN above finished concrete and below.
 - d. Installed with 40MIL minimum coating of cured coal-tar bitumastic paint.

O. Power Feeder Cable Pulling Preparation

1. The following preparation procedures are required for but not limited to service-entrance, critical systems, emergency power, legally required and process critical equipment raceways larger than 3IN.
 - a. Pull conduit wire brush sized for raceway and draw within to remove larger debris.
 - b. Swab raceway by pulling a clean, tight fitting rag through the raceway as many times as required to remove smaller debris, dirt, sand, mud, etc.

- c. Pull mandrel with diameter nominally 1/4IN smaller than the internal diameter of the raceway, to ensure circular cross-section and removal of any obstructions.
- d. Remove water debris from raceway prior to installation of power cables.
- e. Tightly plug ends of conduit with manufactured pipe plugs or plastic conduit inserts until power cables are pulled.
- f. Only nylon or polyethylene rope shall be used to pull power cables in rigid nonmetallic conduit systems.

END OF SECTION

SECTION 26 05 33.16 – BOXES, CABINETS AND ENCLOSURES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish and install all required boxes, cabinets and enclosures used in electrical systems. Types of boxes, cabinets and enclosures specified in this section include but not limited to the following:
 - 1. Terminal, Junction and Pull Boxes
 - 2. Device Boxes
 - 3. Cabinets and Enclosures

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this section, the requirements of Division 26 and those Project Specification Sections referenced therein shall be applied.
- B. Related Specification Sections include but not limited to:
 - 1. Section 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS
 - 2. Section 26 05 29 – ELECTRICAL HANGERS AND SUPPORTS
 - 3. Section 26 05 33.13 – ELECTRICAL RACEWAY SYSTEMS

1.02 REFERENCES

- A. Abbreviations and Acronyms:
 - 1. American Society of Testing and Materials (ASTM)
 - 2. National Electrical Manufacturers Association (NEMA)
 - 3. National Fire Protection Agency (NFPA)
 - 4. Polyvinyl Chloride (PVC)
 - 5. Underwriters Laboratories, Inc. (UL)
- B. Definitions:
 - 1. Cabinet – An enclosure designed for surface mounting or flush mounting with a frame, mat or trim in which a swinging door or doors may be hung
 - 2. Device Box – A box designed to house a unit that carries or controls electric energy as its principal function; such as a receptacle or light switch.

3. Enclosure – A case or housing for electrical wiring and/or components which is utilized to either prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage.
4. Floor Box – A device box designed to be installed in a poured concrete floor.
5. Terminal Box – An enclosure with a screw-fastened cover utilized for splicing or terminating wires.
6. Pull Box – An enclosure with a screw-fastened cover utilized in facilitating the pulling of cable.

C. Reference Standards:

1. ASTM A167 – Standard Specification for Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
2. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)
3. NEMA ICS6 – Enclosures for Industrial Controls and Systems
4. NEMA OS 1 – Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
5. NEMA OS 2 – Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports
6. NFPA 70 – National Electrical Code
7. UL 50 & 50E – Enclosures for Electrical Equipment
8. UL 508A – Industrial Control Panels
9. UL 514A – Metallic Outlet Boxes
10. UL 514B – Conduit, Tubing, and Cable Fittings
11. UL 514C – Nonmetallic Outlet Boxes, Flush Device Boxes and Covers
12. UL 886 – Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
13. UL 1203 – Explosion Proof and Dust Ignition Proof Electrical Equipment for Use in Hazardous (Classified) Locations
14. UL 1773 – Termination Boxes
15. NFPA 496 – Purged and Pressurized Enclosures for Electrical Equipment

D. Qualifications:

1. Each box, cabinet and enclosure shall be listed and labeled by UL, ETL or other recognized testing agency that provides third-party certification follow-up services.
2. Each metallic box, cabinet and enclosure shall have a unique identifying number that traces the product back to material mill test reports. Stainless steel items shall have a part number that contains a material designator or a separate stamp that includes a reference to the type of material used.

1.04 SUBMITTALS

- A. Product data shall be submitted in accordance with DIVISION 01 for each type of box, cabinet or enclosure with a classification greater than NEMA 1. Shop drawings for NEMA 1 boxes, cabinets and enclosures that are non-stock items shall also be submitted.

1.05 DELIVERY, STORAGE AND HANDLING - NOT USED

1.06 OPERATION AND MAINTENANCE MANUALS - NOT USED

1.07 WARRANTY - NOT USED

1.08 IDENTIFICATION

- A. All required boxes, cabinets and enclosures used in electrical systems shall be identified with the equipment tag number indicated on the Contract Documents and the accepted shop drawings. Nameplates shall be furnished and installed as required Specification Section(s):

1. 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 2 - PRODUCTS

2.01 BOXES, CABINETS AND ENCLOSURES

- A. Boxes, cabinets and enclosures shall be of the NEMA Class and of the types and sizes shown on the Contract Documents.
- B. Those sizes not indicated on the Contract Documents shall be sized and applied in accordance with the requirements of NFPA 70 (National Electrical Code).
- C. Unless specified on the Contract Documents, minimum classifications shall be either NEMA 1 or NEMA 12 for dry indoor applications and either NEMA 3R, NEMA 4 or NEMA 4X/SS for outdoor locations, depending on the surrounding environment.
- D. Unless indicated otherwise, metallic boxes, cabinets and enclosures shall be cast-aluminum. Corrosion-resistant screws and hardware, including cadmium and zinc plated items, shall be utilized for dry indoor locations.
- E. Stainless-steel screws and hardware shall be utilized for exterior or wet locations. Boxes, cabinets and enclosures shall be complete with covers, gaskets and any other accessories required for the intended use. Fittings for boxes, cabinets and enclosures shall conform to UL 514B. Malleable iron or zinc plated steel shall be used for conduit hubs, bushings and box connectors.

2.02 PRODUCT TYPES

A. Performance Criteria:

1. Terminal Boxes and Pull Boxes:

Terminal boxes and pull boxes shall be manufactured and applied in accordance with UL 50. Boxes shall have bolted-on, screwed or hinged covers manufactured from the same material as the boxes. Covers shall be of the size and shape to suit the application.

2. Device Boxes:

Device Boxes shall be complete with features and accessories suitable for each location; including mounting brackets, cable clamps, closure plugs, exterior rings and threaded screw holes for devices and covers.

a. Metallic:

Metallic device boxes shall be manufactured from sheet-steel in accordance with NEMA OS 1 and UL 514A. Metallic boxes shall be galvanized, enameled or otherwise corrosion resistant.

b. Nonmetallic:

Nonmetallic device boxes shall be manufactured and applied in accordance with NEMA OS 2 and UL 514C.

3. Cabinets and Enclosures:

Cabinets and enclosures shall be selected, manufactured and applied in accordance with UL 50. Cabinets and enclosures shall consist of a one-piece frame box and front with hinged door or doors. Cabinets and enclosures greater than 36 inches wide shall have double doors. Door(s) shall be constructed to close against a rabbet placed around the inside edge of the frame, with a uniformly close fit between door and frame. Solid neoprene gaskets shall be utilized if required for the application. Door hinges may be flush or concealed and shall be bolted and installed less than 24 inches apart and less than 6 inches from either the top or the bottom of the door.

Flush mounted cabinets and enclosures shall have a front that is 3/4-inch larger than the box all around. Surface mounted cabinets and enclosures shall have a front that is the same height and width as the box.

Cabinets and enclosures not installed in dedicated wiring closets or mechanical/electrical rooms shall have key locks. Cabinets and enclosures for the same system shall be keyed alike and have spare keys. Locks shall allow doors to latch closed without locking.

If required, cabinets and enclosures shall have adequate ventilation, filtration, fans and ducting to compensate for internal heat generation. Cabinets and enclosures shall also have a mounting panel constructed of the same material.

B. Materials: (Refer to drawings or equipment specifications for specific type)

1. Aluminum Sheet Steel:

Sheet aluminum steel boxes, cabinets and enclosures shall be constructed of flat-rolled, code-gauge, galvanized steel aluminum welded with stamped knockouts for raceway entries seams. Covers to be hinged or screwed. Both shall be gasketed.

2. Hot-Dipped Galvanized Steel:

Hot-dipped galvanized steel junction boxes and pull boxes shall be constructed of sheet steel with welded seams. Internal stiffeners shall be provided when necessary to ensure a rigid assembly. Boxes shall be hot-dip galvanized after fabrication.

3. Stainless-Steel:

Stainless-steel junction boxes, pull boxes, cabinets and enclosures shall be fabricated of stainless-steel conforming to Type 304 of ASTM A167. Internal stiffeners shall be provided when necessary to ensure a rigid and structurally sound assembly.

4. Cast-Aluminum:

Cast-aluminum boxes, cabinets and enclosures shall be molded of copper-free aluminum with integral threaded raceway entries.

5. Cast-Iron:

Cast-iron boxes shall be waterproof and molded of an iron alloy with integral threaded raceway entries.

6. Nonmetallic (PVC):

Nonmetallic boxes, cabinets and enclosures shall be molded from gray, nonconductive, glass fiber-reinforced, ultra-violet stabilized, high impact-

resistance strength polyvinyl chloride (PVC) with integral mounting flanges and raceway entries.

C. Finishes:

Metallic boxes, cabinets and enclosures shall have an exterior finish of gray baked enamel and an interior finish of white baked enamel. Mounting panels shall be primed painted white.

PART 3 - EXECUTION

3.01 INSTALLATION

Installation of boxes, cabinets and enclosures shall be in accordance with the electrical plans and details and Article 314 of NFPA 70 (National Electrical Code). Boxes, cabinets and enclosures shall be installed such that the box is supported independently of raceways and cable trays and does not interfere with any other equipment or equipment access. Caps and plugs shall be installed in any raceway entry not utilized. Knockouts on boxes, cabinets and enclosures shall only be removed if required for raceway installation. All burrs and sharp edges shall be removed from knockouts prior to the connection of raceways. Isolation barriers shall be installed between adjacent devices or cables of dissimilar voltage. Boxes, cabinets and enclosures installed in concrete walls shall be deep enough to avoid interference with reinforcing steel, with a maximum depth of six inches.

A. Systems Integration:

1. Terminal Boxes and Pull Boxes:

Terminal boxes shall be installed as required to terminate or tap multiple circuits. Pull boxes or conduit bodies shall be installed on any field routed conduit installation that exceeds 360 degrees of bending and as required to eliminate jamming, excessive sidewall pressures and excessive pulling tensions during cable installation.

2. Device Boxes:

Unless shown otherwise on the lighting and power plans, device boxes shall be installed at the following heights (inches):

Outdoor Receptacle	24
Indoor Receptacle	18
Mechanical Room Receptacle	24
Light Switch	48
Outdoor Telephone Device	48
Indoor Telephone Device	18

Computer/Data Devices	18
Fire Alarm Pull Switches	48
Welding Receptacles	48

Device boxes for light switches and receptacles shall be installed with the long axis of the box in the vertical position. Device boxes for light switches shall be installed at doors on the side opposite the hinges.

Through wall boxes shall not be installed. Device boxes installed back-to-back on common walls shall be installed on opposite sides of a stud to minimize sound transmission. Device boxes installed on columns or pilasters shall be located such that the centers are clear for the future installation of partitions.

Device boxes installed in fire-rated walls or partitions shall have a maximum of 16 square inches of surface area exposed through the wall at one location, unless additional fireproofing material is added. Metallic device boxes installed in fire-rated walls or partitions shall have a minimum of 24 inches of separation.

Device boxes for fixtures installed in finished areas with concealed wiring shall be a minimum of 4 inches square by 1-1/2 inches deep. Extension rings installed on existing device boxes shall have mounting holes drilled to align the extension ring with the existing device box.

3. Cabinets and Enclosures:

Unless otherwise shown on the electrical details, cabinets and enclosures shall be installed such that the tops of the boxes are 78 inches above the finished floor. Cabinets and enclosures installed in finished locations shall be plumb and flush with the finished wall. Pad mounted cabinets and enclosures shall be mounted on concrete surfaces as indicated on either the electrical details or foundation plans. As a minimum, clearances around cabinets and enclosures shall be in accordance with Article 110 of NFPA 70 (National Electrical Code).

3.02 GROUNDING AND BONDING

- A. Metallic boxes, cabinets and enclosures shall be electrically grounded in accordance with Article 250 of NFPA 70 (National Electrical Code) and Section 26 05 26 – GROUNDING & BONDING.

3.03 PROJECT CLOSE OUT

- A. Upon completion of installation, interiors of boxes, cabinets and enclosures shall be inspected, all blockages cleared, and burrs, dirt and construction debris removed. Damaged finishes, including chips, scratches and abrasions, shall be repaired. Damaged galvanized finishes shall be repaired with zinc-rich paint recommended by the manufacturer. Precautions shall be taken to prevent the future entrance of plaster, dirt and debris.

END OF SECTION

SECTION 26 05 33.17 – MANHOLES, HANDHOLES, AND PULLBOXES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:

1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install manholes and handholes for electrical systems Work.

B. Coordination:

1. Coordinate manhole and handhole installation with piping, sheeting other excavation supports, and other Underground Facilities, and locate clear of interferences.
2. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before manhole and handhole for electrical systems Work.

C. Related Sections:

1. Section 03 30 00, Cast in Place Concrete.
2. Section 26 05 43, Underground Duct Banks for Electrical Systems
3. Section 26 05 26 - Grounding and Bonding
4. Section 26 05 01 - Excavation and Concrete Work for Electrical Systems

1.02 REFERENCES

A. Standards referenced in this Section are:

1. AASHTO, Specifications for Highway Bridges.
2. ANSI A14.3, Fixed Ladders – Safety Requirements.
3. ANSI/SCTE 77, Specification for Underground Enclosure Integrity.
4. ASTM A48/A48M, Specification for Gray Iron Castings.
5. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
6. ASTM C478, Specification for Precast Reinforced Concrete Manhole Sections
7. ASTM C1028, Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
8. ASTM D4101, Specification for Polypropylene Injection and Extrusion Materials

1.03 QUALITY ASSURANCE

A. Component Supply and Compatibility:

1. Obtain all manholes and handholes furnished under this Section from a single Supplier, unless otherwise acceptable to ENGINEER.
2. Manhole and handhole Supplier shall review and approve the Shop Drawing submittals for the manholes and handholes furnished.
3. Comply with the National Electrical Code (NEC) and IEEE C2 – National Electrical Safety Code (NESC) for components and installation.
4. Furnish products that are listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) for the application, installation condition, and the environment in which installed.
5. Receive, store, and protect, and handle products according to NECA 1 – Standard Practices for Good Workmanship in Electrical Construction and NECA/NEMA 605 – Recommended Practice for Installing Underground Nonmetallic Utility Duct.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings: (Refer to drawings and details for additional information)
 - a. Manholes: Plan and section drawings showing arrangement of each manhole, including interior and exterior dimensions, elevations, location of manhole wall penetrations, details of typical openings, jointing, inserts, and reinforcing.
 - b. Handholes: Submit schedule of handholes to be furnished and dimensions and pertinent data for each.
 - c. Castings:
 - 1) Schedule of casting types and models to be furnished, with dimensional data and other pertinent data for each.
 - 2) Fabrication and erection of all frame and cover assemblies. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Provide setting drawings for location and installation of castings and anchorage devices.
 - 3) Where Site-specific castings are specified with unique lettering on manhole or handhole cover, provide Shop Drawing for castings indicating appropriate detail to indicate conformance to the Contract Documents.

- d. Layout of Manhole Electrical Systems: Where manholes have extensive details indicating proposed layout of such materials and equipment in each manhole.
2. Product Data:
- a. Manufacturer's technical information, specifications, and literature for manholes, handholes, castings, and accessories proposed for use.

PART 2 – PRODUCTS

2.01 MATERIALS (Refer to drawings and details for additional information)

- A. Material and Construction:
- 1. Material shall be precast or cast in place reinforced concrete. Reinforcing shall be in accordance with Division 03 shall be in accordance with Section 03 30 00, Cast-in-Place Concrete.
 - 2. Provide minimum interior dimensions as shown or indicated. Provide a 12-inch by 12-inch by six-inch deep sump in manhole floor
 - 3. Duct entrances shall be sized and located to suit the ductbanks.
 - 4. Precast Manholes:
 - a. Except where otherwise specified, precast manhole components shall consist of reinforced concrete pipe sections specially designed and constructed for use as manholes and manufactured in accordance with ASTM C478, except as modified in this Section.
 - b. Precast, reinforced concrete manhole bases, riser sections, flat slabs, and other components shall be manufactured by wet-cast methods, using forms that provide smooth surfaces free of irregularities, honeycombing, and other imperfections.
 - c. Joints between manhole components shall be tongue-and-groove type employing a single, continuous rubber O-ring gasket. Circumferential and longitudinal steel reinforcing shall extend into bell and spigot ends of joint without breaking steel continuity. Joints between base sections, riser sections, and top slabs of manholes six feet in diameter and less shall be rubber and concrete joints. Joints for manhole components greater than six-foot diameter shall have steel bell and spigot rings.
 - d. Precast manhole components shall:
 - 1) Have sufficient strength to withstand loads imposed upon them; and be constructed for minimum earth cover loading of 130 pounds per cubic foot, AASHTO H-20 wheel loading,

and an allowance of 30 percent in roadways and 15 percent in rights-of-way for impact.

- 2) Manhole bases shall have two cages of reinforcing steel in the walls, each reinforcing cage shall be of area equal to that required in the riser sections.
 - 3) Wall thickness shall be not less than five inches.
 - 4) Concrete top slabs shall be not less than eight inches thick.
- e. Lifting holes, when provided, shall be tapered. Not more than two lifting holes shall be cast into each section. Provide tapered, solid rubber plugs to seal lifting holes. Lifting holes shall be made to be sealed by plugs driven from the outside face of section only.
 - f. Point of intersection (P.I.) of ductbank centerlines shall be marked with 1/4-inch diameter steel pin firmly enclosed in floor of each manhole base and protruding approximately one-inch above finished floor of base.
 - g. Mark date of manufacture and name or trademark of manufacturer on inside of manhole barrel.
 - h. Barrel of manhole shall be constructed of various lengths of riser pipe manufactured in increments of one foot to provide correct height with the fewest joints. Provide not less than one foot clear between openings in barrel of manholes for ductbanks or other penetrations and the nearest joint. Provide special manhole base or riser sections as required.
 - i. Provide at top of manhole barrel a precast or cast-in-place slab, or precast eccentric cone, as shown or approved, to receive manhole frame and cover.

B. Accessories:

2. Frames and Covers:

- a. Manufacturers: Provide products of one of the following:
 - 1) Neenah Foundry Company.
 - 2) Campbell Foundry Company.
 - 3) Or approved equal.
- b. Material: Covers and frames shall be cast aluminum alloy, rated for AASHTO H-20 loading.
- c. Covers: Watertight, sealed type with hinged and with pneumatic assisted lifting, marked "ELECTRICAL" in raised two-inch letters. Identify covers as shown or indicated on the Drawings.
- d. Grout the frame to the manhole or handhole.

3. Pulling Irons:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Catalog No. 8119 by A.B. Chance Company.
 - 2) Catalog No. DU2T3 by McGraw Edison Company.
 - 3) Or approved equal.
 - b. Material: Galvanized steel.
 - c. Cast in the wall opposite to centerline of each incoming ductbank and 12 inches below centerline of bottom line of ducts.
4. Cable Racks:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) MacLean Power Systems.
 - 2) A.B. Chance Company.
 - 3) Or approved equal.
 - b. Material: Fiber Glass Reinforced.
 - c. Cable racks shall adequately support cables with space allowed for future cables.
 - d. Each rack shall be a vertical assembly of two-foot cable racks extending from within six inches of manhole roof slab to within six inches of manhole floor.
4. Cable Hooks:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Catalog No. J5132A by MacLean Power Systems.
 - 2) Catalog No. C203-1132 by A.B. Chance Company.
 - 3) Or approved equal.
 - b. Material: Galvanized steel.
 - c. Length: 7.5 inch minimum.
5. Insulators:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Catalog No. J5122 by MacLean Power Systems.
 - 2) Catalog No. C203-1120 by A.B. Chance Company.
 - 3) Or approved equal.

- b. Material: Porcelain.
6. Manhole Steps – Polypropylene
- a. Products and Manufacturers: Provide one of the following:
 - 1) P 14938, by Lane International.
 - 2) Or approved equal.
 - b. Material: Polypropylene complying with ASTM D4101 with 1/2-inch diameter Grade 60 steel reinforcing bar complying with ASTM A615/A615M.
 - c. Color: Black
 - d. Provide manhole steps as shown or indicated. Manhole steps shall have raised treads and comply with ANSI A14.3, ASTM C478, and OSHA requirements.
 - e. Steps shall be 15.25 inches wide and, when installed, protrude from manhole wall by six inches.
 - f. Space steps uniformly at a maximum of 12 inches on centers, and project evenly from manhole or chamber walls.

2.02 SMALL HANDHOLES

- A. Material and Construction:
 - 1. Manufacturer: Provide products of one of the following:
 - a. Strongwell Quazite
 - b. Old Castle
 - c. Or approved equal
 - 2. Material: Precast polymer concrete.
 - 3. Duct entrances sized and located to suit ductbanks.
 - 4. Enclosures and covers shall be UL-listed.
 - 5. Enclosures, boxes, and covers shall comply with test provisions of ANSI/SCTE 77 for Tier 15 (15000lb loading) applications.
 - 6. Covers shall have coefficient of friction of not less than 0.50, in accordance with ASTM C1028.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Excavation and Backfill:

1. Provide manholes and handholes for electrical systems where shown or indicated and verify at the Site the required locations.
2. Perform excavation and filling required for installing manholes and handholes for electrical systems, in accordance with Section 26 05 01. This number is correct
3. Provide manholes and handholes on granular subbase course as shown or indicated. If not shown, provide layer of compacted select fill not less than six inches deep on which manhole or handhole for electrical systems will be installed.
4. Carefully set, level, and align at proper grade manhole bases and handholes.

B. Precast Manholes:

1. Set manhole sections vertical with steps and sections in true alignment. Butter the base of each bell or groove end at joints between components with one-to-two proportion cement-sand mortar to provide uniform bearing between components. Seal joints with cement mortar inside and out and trowel smooth to contour of wall surface. Raised or rough joint finishes are unacceptable.
2. Install sections, joints, and gaskets in accordance with manufacturer's recommendations.
3. Tightly seal each lifting hole with solid rubber plug driven into hole from outside of barrel; fill remaining void with one-to-two proportion cement-sand mortar.

C. Manhole and handhole structures shall be watertight. Provide foam sealant to seal all penetrations into manholes and handholes for electrical systems.

D. Cable Supports in Manholes:

1. Attach cable racks with three-inch by 3/8 inch diameter "tamp in" studs mounted in one inch holes drilled into walls of manholes in absence of inserts. Provide PVC coating on racks.
2. Provide cable hooks to support each cable on each rack along the cable run within manholes. Provide PVC coating on hooks.
3. Individually support each cable at each hook on porcelain insulators. Provide sufficient slack for each cable.
4. Securely tie each cable in place at each insulator block to prevent excessive movement of insulators, cables, or fireproof tape. Tie cables with non metallic 3/4 inch strapping tape manufactured by 3M or equal, or tie down with nylon straps.

E. Grounding:

1. Provide 3/4 inch by 10 foot copper clad ground rod for each manhole.
2. Bond all exposed metal manhole accessories and concrete reinforcing rods with No. 4 AWG minimum bare copper wire and connect to ground rod and to the ductbank ground cable.

F. Metal Pull Box:

1. Provide NEMA 4X, stainless steel, wall-mounted pull box inside each manhole and handhole for electrical systems where analog signal cables are mixed with power cables.
2. Route conduits for analog cables directly into and out of metal pull box so that analog cables are not exposed.

G. Grade Rings:

1. Provide grade rings for manholes when required to adjust cover to proper grade. Construct grade ring on manhole roof slab or cone section on which manhole frame and cover will be placed.
2. Height of grade ring shall be as required to bring frame to proper grade and shall not exceed 12 inches in height.

H. Grading at Manholes and Handholes:

1. Unpaved Areas:
 - a. Install manholes and handholes in unpaved areas as shown or directed by ENGINEER to rim elevation higher than finished grade.
 - b. Grade the ground surface to drain away from manholes and handholes.
 - c. Provide fill around manholes and handholes to level of upper rim of manhole or handhole frame, and evenly grade the surface to a one (vertical)-to-five (horizontal) slope to surrounding grade, unless otherwise shown or directed by ENGINEER.
2. Paved or Travelled Areas:
 - a. Install manholes and handholes in paved or travelled areas to meet final grade of paved or concrete surface.
 - b. In paved areas in state or county highways or municipal streets or roads, manholes and handholes shall be 1/2-inch below elevation of final surface course (also known as top course or wearing course) of pavement.

- c. Manholes and handholes shall not project above finished roadway pavement.
3. CONTRACTOR shall be solely responsible for proper height of manholes and handholes necessary to reach final grade. ENGINEER's review of Shop Drawings and other submittals for manholes and handholes is general in nature. Provide random-length precast manhole riser sections to adjust manholes to accommodate field conditions for final grading and final elevations.

3.03 FIELD QUALITY CONTROL

A. Watertightness:

1. Manholes and handholes for electrical systems shall be free of visible leakage. Inspect each manhole and handhole accompanied by ENGINEER, and repair leaks.

END OF SECTION

SECTION 26 05 36– CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

Section includes requirements for cable trays, fittings, supports and accessories used for electrical wiring. Types of cable tray systems specified in this section include the following

1. Ladder Type
2. Solid Bottom Type
3. Channel Type

B. Related Requirements:

1. DIVISION 01 – GENERAL CONDITIONS
2. Section 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS
3. Section 26 05 26 – GROUNDING & BONDING
4. Section 26 05 29 – ELECTRICAL HANGERS AND SUPPORTS
5. Section 25.05.33.13 – ELECTRICAL RACEWAY SYSTEMS

1.02 REFERENCES

A. Abbreviations and Acronyms:

1. American Iron & Steel Institute (AISI)
2. American Society of Testing and Materials (ASTM)
3. American Wire Gauge (AWG)
4. Environmental Testing Laboratory (ETL)
5. National Electrical Manufacturers Association (NEMA)
6. National Fire Protection Agency (NFPA)
7. Underwriters Laboratory, Inc. (UL)

B. Definitions:

1. Cable Tray System – A unit or assembly of units or sections and associated fittings forming a structural system used to securely fasten or support cables and raceways.
2. Channel Type – A prefabricated metal structure consisting of a one-piece ventilated-bottom or solid bottom channel section not exceeding 6 inches in width.

3. Contractor – The Company that has a contract with the Owner to perform the work.
4. Installer – The Contractor or Subcontractor physically installing the electrical equipment or system specified.
5. Ladder Type – A prefabricated metal structure consisting of two longitudinal side rails with transverse rungs welded to the side rails.
6. Power Cable Tray – Cable Tray of any type containing electrical cables operating at a nominal voltage greater than 250 Volts.
7. Solid-Bottom Type - A prefabricated metal structure consisting of a solid bottom with no openings within longitudinal side rails.
8. Subcontractor – The Company that has a contract with the Contractor to perform certain portions of the work.
9. Ventilated Bottom – An opening sufficient for passage of air and using 60 percent or less of plan area for supporting cables
10. Reference NEMA Standards Publication VE 1 for additional definitions of cable tray terminology utilized in this section.

C. Reference Standards:

1. ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
3. ASTM A1008 – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
4. ASTM A1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High Strength Low Alloy with Improved Formability, and Ultra-High Strength
5. ASTM B633 – Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
6. ASTM D635 – Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
7. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials
8. ASTM F1136 – Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
9. NEMA Standards Publication FG 1 – Fiberglass Cable Tray Systems
10. NEMA Standards Publication VE 1 – Metal Cable Tray Systems
11. NEMA Standards Publication VE 2 – Cable Tray Installation Guidelines
12. NFPA 70 – National Electrical Code

1.03 SUBMITTALS

- A. Product data shall be submitted for each type of cable tray system in accordance with the Contract Specifications; including splice plate connectors, expansion joint assemblies and fittings. Information shall include, but not be limited to, types, materials, finishes, dimensions, support points, limitations of use and instructions for storage, handling, protection, examination, preparation and installation.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Cable trays and components shall be listed and labeled by UL, ETL or other nationally recognized testing and listing agencies that provide third-party certification follow-up services and comply with NEMA Standards Publication VE 1 or FG 1.
 - 2. Cable trays and components shall be the product of a single manufacturer.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Delivery and Acceptance Requirements:
 - 1. Contractor shall not accept any cable tray components that have been broken, bent, dented or scored in anyway during the course of delivery.
- B. Storage and Handling Requirements:
 - 1. Cable tray components shall be stored in original cartons in a clean dry space; protected from both weather and construction traffic. Wet materials shall be unpacked and dried before storage.
 - 2. Contractor or Subcontractor shall be diligent in making every effort not to damage any cable trays, components or accessories by careless storage or handling.

PART 2 - PRODUCTS

2.01 CABLE TRAY SYSTEMS

- A. Cable tray systems shall be of the NEMA Class and of the types and sizes shown on the cable tray plans, sections, details and bill of materials. Cable tray components shall have rounded edges and smooth surfaces. Cable Tray systems shall be manufactured, tested and applied in accordance with NEMA Publications FG 1 or VE 1.

2.02 PRODUCT TYPES

A. Manufacturers:

1. Allied Electrical Group/Cope
2. Chalfant Manufacturing Company
3. Cooper B-Line
4. LeGrand Cablofil
5. MP Husky Corporation
6. Schneider Electric/Square D
7. Thomas & Betts Corporation
8. Contractor approved equal

B. Performance Criteria:

1. Ladder Type:

4" height minimum, ladder type cable tray and fittings shall consist of rungs welded to longitudinal side rails, forming the bottom of the cable tray assembly. Cross-rung spacing shall be 9 inches on center. Rungs shall have a minimum cable-bearing surface of 7/8 inch with rounded edges. No portion of the rungs shall protrude below the bottom plane of the side rails. Each rung must be capable of supporting the maximum cable load, with a safety factor of 1.5 and a 200-pound concentrated load. Cable tray span loading shall be 100lbs/ft. with tray supports at a maximum of 10 feet. Deflection shall not exceed 1/2".

2. Solid Bottom Type:

Solid Bottom Type cable tray and fittings shall consist of a solid bottom with no openings continuously welded to longitudinal side rails, forming the bottom of the cable tray assembly. The solid bottom shall be capable of supporting the maximum cable load with a safety factor of 1.5.

3. Channel Type:

Channel Type cable tray and fittings shall be a completely prefabricated metal structure consisting of a one-piece [ventilated] [non-ventilated] bottom channel section.

C. Materials:

1. Aluminum:

Side rails and rungs for cable trays and fittings shall be extruded from Aluminum Association Alloy 6063. Fabricated components, such as

expansion plates, splice plates and covers, shall be constructed from Aluminum Association Alloy 5052.

- D. Assembly: Cable tray systems shall be completely assembled with new and unused parts. Outdoor installations shall utilize stainless steel hardware. Indoor installations may utilize stainless steel or zinc plated hardware. Cable tray assemblies shall be complete with manufacturer's recommended standard covers, barrier strips, dropouts, fittings, conduit adapters, hold down devices, grommets and blind ends as required. Cable tray covers and barrier strips shall be of the same material, finish and size as the cable tray system. Covers shall be [solid type] [louvered type] [ventilated-hat type]. Fittings utilized in the cable tray system shall be of the sizes shown on the cable tray plans, sections, details and bill of materials. Fittings shall have a minimum radius of 12 inches and be of the same material, height and width as the straight runs.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Burrs and sharp edges of field-cut cable trays shall be removed prior to installation. Hot-dip Galvanized Steel cable trays shall be inspected to ensure all sharp edges, icicles and excess zinc has been removed.

3.02 INSTALLATION

Cable trays shall be installed as shown on the cable tray plans and sections and in accordance with the manufacturer's instructions. Cable trays shall be installed for the sole purpose of supporting cables and raceways. Cable trays shall not be used as platforms or ladders by personnel.

- A. Systems Integration:
1. Changes in direction of cable tray shall be made with standard cable tray fittings. Cable trays shall be installed above piping with sufficient space above and between trays to permit access for installing cables and as otherwise shown on the cable tray plans and sections.
 2. Installer shall follow the manufacturer's instructions for selection and installation of cable tray supports. Supports shall be located in accordance with the recommendations of Section 4 (Installation) of NEMA Standards Publication VE 2, the manufacturer's instructions or the engineered support drawings. If there is a discrepancy between these documents, then the engineered drawings shall take precedence. The strength of each support, including fastenings to the structure, shall be adequate to carry present and future load with a safety factor of 200 pounds or four times the total expected load, whichever is greater. Cable tray supports and hardware

shall be installed in accordance with Section 26 05 29 – ELECTRICAL HANGERS AND SUPPORTS.

3. Splice plates shall be bolted type made by the same manufacturer as the cable tray. Splice plate construction shall be such that a splice may be located anywhere within the support span without diminishing the rated loading capacity of the cable tray.
4. Expansion splice plates shall be installed in cable tray installations exceeding 90 feet for aluminum tray and 175 feet for steel tray. Maximum spacing between expansion splice plates shall not exceed the maximum spans indicated in Table 4-2 of NEMA Standards Publication VE 2 or as shown on the cable tray installation details. Gap settings for expansion splice plates shall be in accordance with Figure 4.1313 of NEMA Standards Publication VE 2 or as shown on the cable tray installation details. Hold down and guide clamp locations shall be in accordance with Figure 4.13A of NEMA Standards Publication VE 2 or as shown on the cable tray plans and sections. Supports shall be located within 2 feet of each side of expansion plates or as shown on the cable tray plans and sections. All hardware (nuts, bolts, washers) supplied with expansion plates shall be installed per manufacturer's instructions.
5. Barriers shall be installed as specified on the cable tray plans and sections to separate conductors of different systems, such as power, communications, instrumentation and control, or conductors rated for different voltage levels.
6. Cable trays connecting to equipment shall utilize flanged fittings fastened to the tray and to the equipment enclosure. Cable trays shall be supported independently such that the weight of the cable tray shall not be imposed on the equipment enclosure.
7. Cable trays penetrating fire and smoke barriers, including walls, partitions, floors and ceilings, shall utilize fire stopping material. Fire stopping material shall be installed after the installation of cables. Fire stopping material may be silicone RTV foam, intumescent caulk or fire-rated sealing plugs or modules. The fire rating of the penetrated barrier shall be restored to its original rating. Capped sleeves for future cables shall be installed through the penetrated barrier.
8. Cable tray covers shall be installed outdoors in accordance with the cable tray plans or bill of materials. Heavy duty wrap around cover clamps shall be utilized at intervals called out on the cable tray drawings or per the manufacturer's instructions.

3.03 GROUNDING AND BONDING

- A. Cable trays shall be electrically grounded utilizing UL listed cable tray grounding clamps to ensure continuous electrical conductivity of the cable tray system. Cable tray grounding shall be installed in accordance with Articles 250 and 392 of NFPA 70 (National Electrical Code) and Sections 4.7 and 4.8 of NEMA Standards

Publication VE 2. Unless specified on the cable tray plans and details, the cable tray system shall not be used as an equipment grounding conductor.

- B. A #4/0 AWG copper grounding conductor shall be bonded to the tray every 50 feet and installed the continuous length of each Power Cable Tray. A green insulated grounding conductor shall be utilized on aluminum cable tray systems. At tees, crosses, wyes and drop-outs, a #4/0 AWG tap conductor shall be clamped to the main ground conductor and installed the continuous length of the tray section. Power Cable Trays shall be bonded to grounded structural steel or the plant grounding grid every 50 feet.
- C. Conduits attached to cable trays shall be attached with cable tray-to-conduit clamps, UL listed for grounding, or utilize bonding jumpers. Bonding jumpers shall be installed across each expansion fitting.

3.04 SITE QUALITY CONTROL

- A. Site Tests and Inspections: All trays, fittings and components shall be inspected and tested as a complete system to ensure electrical continuity of bonding and grounding connections.

3.05 CLEANING

- A. Upon completion of installation, the cable tray system shall be inspected and burrs, dirt and construction debris shall be removed. Damaged finishes, including chips, scratches and abrasions, shall be repaired. Damaged galvanized finishes shall be repaired with a zinc-rich paint recommended by the manufacturer.

3.06 CLOSEOUT ACTIVITIES

- A. Adhesive-backed vinyl warning signs shall be installed on Power Cable Trays in accordance with Article 392.18(H) of NFPA 70 (National Electrical Code). Labels shall also be installed on all trays identifying the cable tray number as indicated on the cable tray plans and sections and raceway schedule. Labels shall have minimum 1 inch high characters and comply with ANSI specifications for colors.

END OF SECTION

SECTION 26 05 43 – UNDERGROUND DUCTBANKS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install underground ductbanks.

B. Coordination:

1. Ductbank routing on the Drawings is diagrammatic. Coordinate installation with piping and other Underground Facilities and locate ductbanks clear of interferences.
2. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before underground ductbank Work.

C. Related Sections:

1. Division 01
2. Section 03 30 00, Cast in Place Concrete.
3. Section 26 00 15, Identification for Electrical Systems.
4. Section 26 05 01 – Excavation and Concrete Work for Electrical Systems
5. Section 26 05 26 – Grounding and Bonding
6. Section 26 05 33.13 – Electrical Raceway Systems
7. Section 26 05 30.10 – Electrical Cable Installation in Raceway Systems
8. Section 26 05 33.17 – Manholes, Handholes and Pullboxes

1.02 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Layouts showing proposed routing of ductbanks and locations of manholes, handholes, and areas of reinforcement.
 - b. Profiles of ductbanks showing crossings with piping and other Underground Facilities.
 - c. Typical cross sections for each ductbank.

- B. Informational Submittals: Submit the following:
 - 1. Special Procedure Submittals:
 - a. Installation procedures.
 - 2. Field Quality Control Submittals:
 - a. Field test report.
- C. Closeout Submittals: Submit the following:
 - 1. Record Drawings:
 - a. Include actual routing of underground ductbank runs on record documents in accordance City of Clearwater Section III

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Duct: Provide conduit and fittings in accordance with Section 26 05 33.13 Electrical Raceway Systems Conduit types shall be as follows:
 - 1. Schedule 40 PVC conduits for power circuits.
 - 2. Schedule 40 PVC conduits for the following types of circuits: low voltage status, analog, and communication.
- B. Backfill: Provide backfill, including select backfill, in accordance with 26 05 01
- C. Concrete: Provide ductbank concrete in accordance with Section 03 30 00, Cast-in-Place Concrete.
- D. Grounding: Provide ground cable in accordance with Section 26 05 26, Grounding and Bonding.
- E. Conduit Spacers: Conduit spacers shall be nonmetallic, interlocking type to maintain spacing between conduits. Provide spacers suitable for all conduit types used in multiple sizes.
- F. Duct Sealing Compound:
 - 1. Products and Manufacturers: Provide one of the following:
 - a. 0-Z/Gedney, Type DUX.
 - b. Or approved equal.

H. Electrical Duct Spacers

1. Spacers shall be utilized in the fabrication of Underground Duct-Bank Systems.
2. Spacers shall be installed no more than 6FT intervals. Spacers may be staggered to accommodate sweeping bends with a large radius. Additional, non-metallic banding shall be utilized as required to prevent shifting or floating during concrete placement.
3. Spacers shall rest on concrete blocks or bricks to reduce sinking and allow for proper, bottom concrete coverage.
4. Underground Duct-Bank Systems shall be securely anchored through reinforcing steel; to prevent floating during concrete placement.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Excavation and Backfilling:

1. Provide excavation and backfilling for ductbank installation in accordance with Section 26 05 43.
2. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials that can damage or contribute to corrosion of ducts or cables, or prevent adequate compaction of backfill.

B. Ductbank Layout:

1. Top of ductbank concrete shall be a minimum of 2.0 feet below grade, unless shown or indicated otherwise on the Drawings.
2. Slope ductbank runs for drainage toward manholes and away from buildings with slope of approximately three inches vertical per 100 feet of run.

C. Ductbank Assembly:

1. Assemble ductbanks using non magnetic saddles, spacers, and separators. Position separators to provide minimum three-inch concrete separation between outer surfaces of each conduit. Provide side forms for each ductbank.

2. Make bends with sweeps of not less than four-foot radius or five-degree angle couplings.

D. Concrete Placing:

1. Provide minimum four-inch concrete covering on each side, top, and bottom of concrete envelopes around conduits. Concrete covering shall be as shown or indicated on the Drawings.
2. Provide red dye in concrete for easy identification during subsequent excavation; all concrete in entire ductbank, including top and bottom, shall be dyed.
3. Firmly fix conduits in place during concrete placing. Carefully place and vibrate concrete to fill spaces between conduits.

E. Conduit Transitions:

1. Conduit installations shall be watertight throughout entire length of ductbank.
2. Transition from non metallic to galvanized rigid steel conduit where ductbanks enter structure walls and slabs.
3. Terminate conduits in insulated grounding bushings.
4. Continue conduits inside buildings in accordance with Section 26 05 33.13, Electrical Raceway System, and as shown or indicated in the Contract Documents.
5. If ducts are not concrete-encased, provide expansion and deflection fittings in accordance with Section 26 05 43.
6. Plug and seal empty spare conduits entering structures. Conduits in use entering structures shall be sealed watertight with duct sealing compound.

F. Ductbank Reinforcing:

1. Provide reinforcing for all ductbanks:
2. Install ductbank reinforcement as shown or indicated on the Drawings.
3. Provide maximum clearance of 2.0 inches from bars to edge of concrete encasement.
4. Provide maximum clearance of 2.0 inches from bars to edge of conduit.

G. Connections to Structures:

1. Firmly anchor ductbanks to structure walls or slabs. Epoxy-grout ductbank rebar into structure concrete to eliminate sheer forces between ductbank and structure wall concrete.
2. Ductbank penetrations through structure walls shall be watertight.

H. Grounding:

1. Provide bare stranded copper ductbank ground cable in each ductbank envelope. Make ground electrically continuous throughout entire ductbank system.
2. Connect ground cable to building and station ground grid or to equipment ground buses. Also, connect ground cable to steel conduit extensions of underground ductbank system.
3. Provide ground clamp and bonding of each steel conduit extension to maintain continuity of ground system.
4. Terminate ground cable at last manhole or handhole for outlying structures.

I. Detectable Underground Warning Tape:

1. Provide detectable underground warning tapes complying with Section 26 00 15, Identification for Electrical Systems, over the full length of each underground ductbank.
2. Install warning tapes approximately 12 inches below grade.
3. Provide multiple tapes across the width of each ductbank. Locate center of a warning tape above each edge of ductbank, and at intervals across top width of ductbank so that clear space between tapes does not exceed six inches.

J. Reused Existing Ducts:

1. Pull rag swab through duct to remove water and to clean conduits prior to installing new cable.
2. Repeat swabbing until all foreign material is removed.
3. Pull mandrel through duct, if necessary, to remove obstructions.

END OF SECTION

SECTION 26 22 00 DRY – TYPE TRANSFORMERS – 600V

PART 1 - GENERAL

1.01 REQUIREMENT SUMMARY

- A. Specification Section includes Dry-Type Distribution Transformers with primary and secondary voltages of less than or equal to 600V, and with capacity ratings through 225kVA.
- B. Contractor shall furnish, install, and test transformers for power and lighting distribution systems as described herein, as shown on the Contract Documents, and as required to complete the electrical installations.
- C. All equipment specified in this Section shall be furnished by the transformer manufacturer who shall be responsible for the suitability and compatibility of all included equipment.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this section, the requirements of Division 26 and those Project Specification Sections referenced therein shall be applied.
- B. Related Specification Sections include but not limited to:
 - 1. 09 90 00 – PAINTING AND PROTECTIVE COATINGS

1.03 REFERENCES

- A. Transformers shall comply with the following applicable codes and standards as well as any others within the specifications and drawings. In the event of any conflict between these codes, regulations, standards, and Contract Documents, the most restrictive shall apply.
- B. Codes and Standards
 - 1. NFPA 70 - National Electrical Code
 - 2. NEMA ST20
 - 3. Underwriters Laboratory (UL)
 - a. UL 1561 – Dry-Type General Purpose and Power Transformers
 - b. UL 250 - Enclosure for Electrical Equipment
 - c. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers
 - 4. 2005 Energy Act: Public Law 109–58 Aug 8, 2005; Comply with all Rules from Department of Energy
 - a. 10 CFR 429
 - b. 10 CFR 431

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per Specification Sections:
 - 1. 01 33 00 – SUBMITTAL PROCEDURES
- B. Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Operation and Maintenance Manuals
 - 3. Spare Parts List
 - 4. Special Tools List
 - 5. Reports of Certified Shop Tests
- C. Each submittal shall be identified by the applicable Specification Section.
- D. Shop Drawings
 - 1. Submittals shall be complete in all respects, incorporating all information and data listed herein, and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
 - 2. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
 - 3. Shop drawings shall include but not be limited to:
 - a. Equipment specifications and product data sheets identifying all materials used and methods of fabrication.
 - b. Drawings showing clearly marked dimensions for each transformer.
 - c. Sample equipment nameplate diagram.
 - 4. Submittal information shall reflect the specific equipment identification number as indicated on the Contract Documents.
 - 5. Shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.

1.05 OPERATION AND MAINTENANCE MANUALS

- A. Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.

1.06 TOOLS, SUPPLIES AND SPARE PARTS

- A. Transformers shall be furnished with all special tools necessary to disassemble, service, repair and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.
- B. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.07 IDENTIFICATION

- A. Transformers shall be identified with the equipment tag number indicated on the Contract Documents and the accepted shop drawings. A nameplate shall be securely affixed in a conspicuous place on each transformer. Nameplates shall be furnished and installed as required Specification Section(s):

- 1. 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Contract Documents.
- B. Subject to compliance with the Contract Documents all Dry Type Transformers shall be of the same manufacturer and provided by:
 - 1. Square-D
 - 2. Cutler-Hammer
 - 3. General Electric
 - 4. Acceptable as Specified in the Owner's Approved Products List

2.02 DRY-TYPE TRANSFORMERS

- A. Contractor shall furnish and install single-phase and three-phase general purpose, dry-type transformers, as specified herein and indicated on the Contract Documents. The transformers shall be 60Hz, self – cooled, quiet design insulated of the two winding type.
- B. The transformers shall be Underwriters Laboratories, Inc. listed and shall bear the UL label.
- C. Ratings:

1. The primary windings shall be rated 480VAC for use on 3 phase, 3 wire systems and connected delta unless indicated otherwise in the Contract Documents. The kVA ratings shall be as shown in the Contract Documents. Furnish taps for transformers as follows:
 - a. 1 PH, 25kVA and below: Two 5% FCBN
 - b. 3 PH, 15kVA and below: Two 5% FCBN
 - c. 3 PH, 30kVA and above: Two 2.5% FCAN and four 2.5% FCBN
 2. All taps shall be full capacity rated
 3. Ratings of the secondary windings shall be as indicated on the Contract Documents.
- D. Construction:
1. Transformers shall be designed for continuous operation at rated kVA, 24 hours a day, 365 days a year, with normal life expectancy as defined in IEEE 65 and ANSI C57.96. This performance shall be obtainable without exceeding 150C average temperature rise by resistance or 180C hot spot temperature rise in a 40C maximum ambient and 30C average ambient. The maximum coil hot spot temperature shall not exceed 220C. All insulating materials shall be flame retardant and shall not support combustion as defined in ASTM Standard Test Method D 635. All insulating materials shall be in accordance with NEMA ST20 Standard for a 220C UL component recognized insulation system.
 2. Transformer coils shall be of the continuous wound copper construction and shall be impregnated with non-hygroscopic, thermosetting varnish.
 3. Transformers shall have copper windings.
 4. All cores are to be constructed of high grade, nonaging, grain oriented silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be tightly clamped and compressed with structural steel angles. The completed core and coil shall then be bolted to the base by means of vibration absorbing mounts to minimize sound transmission. There shall be no metal to metal contact between the core and coil assembly and the enclosure.
 5. Indoor non-classified enclosures shall be made of heavy gauge steel and shall be degreased, cleaned, primed, and finished with a baked weather-resistant enamel. See painting requirements specified in this section. Outdoor enclosures or enclosures within a corrosive area shall be constructed of stainless steel and rated NEMA 4X.
 6. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90C. Transformers shall be furnished with lugs of the size and quantity required and suitable for termination of the field wiring.
 7. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA, IEEE, and ANSI standards.

8. Transformers shall be mounted on neoprene-rubber isolation pads. The transformers shall not exceed the following ANSI sound levels:
 - a. 0 to 9kVA 37dB
 - b. 10 to 30kVA 42dB
 - c. 31 to 50kVA 45dB
 - d. 51 to 150kVA 50dB
 - e. 151 to 225kVA 55dB

2.03 DRY-TYPE RESIN ENCAPSULATED TRANSFORMERS

- A. Furnish and install single-phase and three-phase general purpose, dry-type resin encased transformers, as specified herein and indicated in the Contract Documents. Transformers shall be 60Hz, self-cooling, quiet design insulated of the two winding type.
- B. Transformers shall be Underwriters Laboratories, Inc. listed and shall bear the UL label.
- C. Ratings:
 1. Single phase transformers shall be 480V primary with 240/120V secondary.
 2. Three phase transformers shall be 480V primary and 208/120V secondary.
 3. kVA ratings shall be as shown in the Contract Documents
 4. Transformers shall a minimum of 2 – 5% full capacity primary taps below normal and shall be rated 115-degrees Celsius temperature rise above 40C maximum ambient.
- D. Construction:
 1. Transformers shall be designed for continuous operation at rated kVA, 24 hours a day, 365 days a year, with normal life expectancy as defined in IEEE 65 and ANSI C57.96. This performance shall be obtainable without exceeding 150C average temperature rise by resistance or 180C hot spot temperature rise in a 40C maximum ambient and 30C average ambient. The maximum coil hot spot temperature shall not exceed 220C. All insulating materials shall be flame retardant and shall not support combustion as defined in ASTM Standard Test Method D 635. All insulating materials shall be in accordance with NEMA ST20 Standard for a 185C UL component recognized insulation system.
 2. Transformers are to be encapsulated using a sand-epoxy resin mixture to provide maximum protection against moisture, dust and corrosive environments.
 3. Transformer coils shall be of the continuous wound copper construction and shall be impregnated with non-hygroscopic, thermosetting varnish.
 4. Transformers shall have copper windings.
 5. All cores are to be constructed of high grade, nonaging, grain oriented silicon steel with high magnetic permeability and low hysteresis and eddy

current losses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be tightly clamped and compressed with structural steel angles. The completed core and coil shall then be bolted to the base by means of vibration absorbing mounts to minimize sound transmission. There shall be no metal to metal contact between the core and coil assembly and the enclosure.

6. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA, IEEE, and ANSI standards.

2.04 PAINTING

- A. The exteriors of the transformer enclosures shall be painted as follows:
 1. Factory painting: Surfaces shall be cleaned, phosphatized and carefully primed with basic lead chromate. This shall be followed by two coats of an electrostatic powder paint.
 2. Field painting: After delivery and installation, but before transformers are placed in service, all factory-painted surfaces shall be carefully cleaned and all abrasions shall be repaired.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Transformers shall be furnished and installed as shown in the Contract Documents and as recommended by the equipment manufacturer.
- B. Raceways routed to and from the transformer shall be arranged for easy removal of the transformer.
 1. Flexible raceways shall be utilized to make wiring connections to transformers and bonded in accordance with applicable NEC Articles.
- C. Where required and/or as shown in the Contract Documents, Contractor shall provide and install manufacturer supplied wall-mount brackets for those wall-mounted transformers.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:
 1. Witnessed Shop Tests: None required.
 2. Certified Shop Tests:
 - a. Transformers shall be given routine factory tests in accordance with the requirements of the ANSI and NEMA standards. Temperature rises may be certified from basic design.
 - b. As a minimum, the following tests shall be made on all transformers:

- 1) Ratio tests on the rated voltage connection and on all tap connections.
 - 2) Polarity and phase-relation tests on the rated voltage connection.
 - 3) Polarity and phase-relation tests on the rated voltage connection.
 - 4) Applied potential tests.
 - 5) Induced potential tests.
 - 6) No-load and excitation current at rated voltage on the rated voltage connection.
3. Field Tests
- a. Field testing shall be done in accordance with the requirements specified in Specification Section(s):
 - 1) Division 2 – SITE CONSTRUCTION
 - 2) 26 00 10 – TESTING AND COMMISSIONING OF ELECTRICAL SYSTEMS
 - b. After installation, the transformers shall be subjected to routine insulation resistance tests. The tests shall be made by the Contractor who shall also furnish the required testing equipment.

END OF SECTION

SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.01 REQUIREMENT SUMMARY

- A. Refer to specification 26 23 00 for information on Main and Tie Section construction.
- B. Contractor shall furnish and install floor-mounted dead-front low-voltage Switchboards which consist of an enclosure, circuit breakers, instruments and metering equipment, monitoring equipment or control equipment, with associated interconnections and supporting structures connected solidly (bussed) to Metal-Enclosed Draw-Out Switchgear as indicated on the Contract Documents and as specified herein.
 - 1. Distribution Switchboard - Furnish and install the distribution switchboard(s) shown on the Contract Documents and specified in this Specification Section.
 - 2. Provide Integrated Power Center 2 switchboard with transformer.
- C. Equipment supplier shall perform and provide all data and reports as required for the Switchboards and all associated connected loads as shown in the Contractor Documents in accordance with the Project Specification Sections.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this Section, the requirements of Division 26 and those Project Specification Sections referenced therein shall be applied.
- B. Related Specification Sections include but not limited to:
 - 1. 26 00 05 – SHORT-CIRCUIT COORDINATION AND ARC-FLASH ANALYSIS
 - 2. 26 43 00 – SURGE PROTECTIVE DEVICES – 600V

1.03 REFERENCES

- A. Switchboards and overcurrent protection devices referenced herein are designed and manufactured according to the following appropriate codes and regulations.
- B. Codes and Standards:

1. ANSI/NFPA 70 - National Electric al Code (NEC).
2. ANSI/IEEE C12.16 - Solid-State Electricity Metering.
3. ANSI C57.13 - Instrument Transformers.
4. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
5. NEMA PB 2 - Deadfront Distribution Switchboards, File E8681
6. NEMA PB 2.1 - Proper Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
7. NEMA PB 2.2 - Application Guide for Ground Fault Protective Devices for Equipment.
8. UL 50 - Cabinets and Boxes.
9. UL 98 - Enclosed and Dead Front Switches.
10. UL 489 - Molded Case Circuit Breakers.
11. UL 891 - Dead-Front Switchboards.
12. UL 943 - Standard for Ground Fault Circuit Interrupters.
13. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit and Service.

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per the Contract Specifications.
- B. For Engineer Review
 1. The following information shall be submitted to the Engineer:
 - a. Master drawing index
 - b. Front view and plan view of the assembly
 - c. Three-line diagrams
 - d. Schematic diagrams
 - e. Nameplate schedule
 - f. Component list
 - g. Conduit space locations within the assembly
 - h. Assembly ratings include but not limited to:
 - 1) Short-circuit rating
 - 2) Voltage
 - 3) Continuous current rating
 - i. Major component ratings include but not limited to:
 - 1) Voltage
 - 2) Continuous current rating
 - 3) Interrupting ratings
 - j. Cable terminal sizes
 - k. Product data sheets

2. Where applicable, the following additional information shall be submitted to the Engineer:

- a. Busway connection(s)
- b. Composite front view and plan view of close-coupled assemblies

C. For Construction

1. The following information shall be submitted for record purposes:

- a. Final as-built drawings and information for items listed in Section 1.4B, and shall incorporate all changes made during the manufacturing process
- b. Wiring diagram(s)
- c. Certified production test report(s)
- d. Installation information

D. Qualifications

- 1. For approval, manufacturer shall have specialized in the manufacturing and assembly of Switchboards for at least fifty (50) years.
- 2. Furnish products listed by Underwriters Laboratories Incorporated and in accordance with standards listed in Section 1.3.
- 3. Manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- 4. Equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- 5. Switchboards shall bear a UL 891 label.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Switchboards and all components shipped loose shall be handled and stored in accordance with manufacturer's instructions and recommendations as outlined in applicable Installation and Maintenance Manuals. Three (3) copies of these instructions shall be included with the equipment at time of shipment.
- B. Switchboards section(s) shall be delivered in individual shipping splits for ease of handling. Sections shall be individually wrapped for protection and mounted on shipping skids as required to prevent tipping.
- C. Inspect and report concealed damage to carrier within their required time period. Owner is not responsible for damages incurred during shipping, handling and storage.
- D. Store in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect structure from dirt, water,

construction debris, and traffic. Where applicable, provide adequate heating within enclosures to prevent condensation.

1.06 OPERATION AND MAINTENANCE MANUALS

- A. Switchboards operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.
 - 1. Operation and Maintenance manuals, drawings etc. to be provided within the assemblies shall be water-proof and fire-resistant utilizing tear-resistant paper.

1.07 WARRANTY

- A. Manufacturer shall warrant Switchboards to be free from defects in materials and workmanship for the lesser of one (1) year from date of installation or eighteen (18) months from date of purchase.

1.08 IDENTIFICATION

- A. Switchboards shall be identified with the equipment tag number indicated on the Contract Documents and the accepted shop drawings. Nameplate(s) shall be securely affixed in a conspicuous place on Metal-Enclosed Draw-Out Switchgear. Nameplates shall be furnished and installed as required Specification Section(s):
 - 1. 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Switchboards shall be provided by one of the manufacturers listed:
 - 1. Square D / Schneider Electric USA
 - 2. Acceptable as Specified in the Owner's Approved Products List
- B. Manufacturer of Switchboards shall be the same as the manufacturer of the circuit breakers or the switches mounted within Switchboards.
- C. Switchboards shall be by the same manufacture as the Metal-Enclosed Draw-Out Switchgear for the purposes of stocking common breaker types, series ratings, etc.

2.02 SWITCHBOARD – GENERAL

- A. Short Circuit Current Rating: Switchboards shall be rated with a minimum short circuit current rating of 35kA RMS symmetrical at 600VAC maximum.
- B. Future Provisions: All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
 - 1. Enclosure: NEMA 1G/12
- C. Sections shall be aligned front and rear.
- D. Removable steel base channels 1.5IN shall be bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting.
- E. Switchboards enclosure shall be painted on all exterior surfaces. The paint finish shall be a medium gray, ANSI #49, applied by the electro-deposition process over an iron phosphate pre-treatment.
- F. All front covers shall be screw removable with a single tool and all doors shall be hinged with removable hinge pins.
- G. Top and bottom conduit termination areas shall be clearly indicated on shop drawings.

2.03 NAMEPLATES

- A. Engraved nameplates, mounted on the face of the Switchboards, shall be furnished for all main and feeder circuits as indicated in the Contract Documents; reference Section 1.8.
- B. Furnish master nameplate giving Switchboard's designation, voltage ampere rating, short-circuit rating, and manufacturer's name.
- C. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's drawings.

2.04 BUS

- A. All bus bars shall be tin-plated copper. Plating shall be applied continuously to all bus work. Switchboards bussing shall be of sufficient cross-sectional area to meet UL Standard 891 temperature rise requirements. The phase and neutral through-bus shall have an ampacity as shown in the Contract Documents. The neutral shall be of equivalent ampacity as the phase bus bar. Tapered bus is not acceptable.

- B. Full provisions for the addition of future sections shall be provided. Bussing shall include all necessary hardware to accommodate splicing for future additions.
- C. Connections shall be bolted with Grade 5 bolts and conical spring washers.
- D. Ground bus shall be sized per NFPA70 and UL 891 Tables 25.1 and 25.2 and shall extend the entire length of the Switchboard. Provisions for the addition of future sections shall be provided.

2.05 WIRING / TERMINATIONS

- A. Small wiring, necessary fuse blocks and terminal blocks within the Switchboards shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
- B. All control wire shall be type SIS and 14AWG for control circuits. Wire bundles shall be secured with nylon ties and anchored to the assembly with the use of pre-punched wire lances or nylon non-adhesive anchors. All groups of control wires leaving the Switchboards shall be provided with screw-cage terminal blocks with suitable numbering strips and provisions for 10AWG field connections. Provide printed heat-shrink sleeve wire markers at each end of all control wiring. Plug-in terminal blocks shall be provided for all shipping split control wires. Terminal connections to remote devices or sources shall be front accessible via doors above each circuit breaker.

2.06 SWITCHBOARD – DISTRIBUTION SECTION

- A. General:
 - 1. Distribution section shall be of the configuration and ratings as shown on the Contract Documents. Distribution section shall be dead front type with automatic trip-free, non-adjustable, thermal overload branch circuit breakers, unless otherwise shown in the Contract Documents. Distribution circuit breakers shall be bolt-on molded case type conforming to NEMA Standard AB1. Trip elements of the circuit breakers shall be rated shall be as shown in the Contract Documents.
 - 2. Distribution Section shall consist of those requirements listed in this Specification.

2.07 FINISH

- A. All exterior and interior steel surfaces of Switchboards shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish shall be ANSI 61.

2.08 SURGE PROTECTIVE DEVICES

- A. Provide surge protective devices as indicated in Contract Documents and as specified in Specification Section(s):
 - 1. 26 43 00 - SURGE PROTECTIVE DEVICES – 600V

2.09 SPARE PARTS AND ACCESSORIES

- A. Provide spare parts for Switchboards as recommended by the manufacturer.

PART 3 - EXECUTION

3.01 FACTORY ACCEPTANCE TESTING

- A. All Switchboards shall go through a standardized Factory Acceptance Test (FAT) prior to shipment. FAT shall include, but not limited to, the following:
 - 1. After assembly, the complete Switchboard shall be tested to ensure the accuracy of the wiring and the functioning of all equipment.
 - 2. Main bus system shall be given a dielectric test of 2.2kV for one minute (1MIN) between live parts and ground and between opposite polarities.
- B. A certified test report of all standard FAT procedures, tests, results and corrective actions shall be shipped with Switchboards.
- C. Manufacturer shall notify Engineer two (2) weeks prior to the date the tests are to be performed

3.02 EXAMINATION

- A. Examine concrete flooring and/or concrete equipment pad(s) to receive Switchboards for compliance with installation tolerances and other conditions affecting performance of the product as required by the manufacturers installation instructions and recommendations to include Engineer installation details. Do not proceed with installation until unsatisfactory conditions have been met or corrective action has been taken.

3.03 INSTALLATION

- A. Contractor shall install Switchboards per the manufacturer's recommendations and the Contract Documents.
- B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

- C. Switchboards shall be installed and checked in accordance with the manufacturer's recommendations. This shall include but not limited to:
 - 1. Checking to ensure that concrete flooring and/or concrete equipment pad(s) are level to within 0.125IN per 3FT feet of distance in any direction; reference Section 2.3B.
 - 2. Checking to ensure that all bus bars are torqued to the manufacturer's recommendations
 - 3. Assembling all shipping sections, removing all shipping braces and connecting all shipping split mechanical and electrical connections
 - 4. Securing Switchboards to concrete flooring and/or concrete equipment pad(s).
 - 5. Inspecting and installing all circuit breakers in their proper compartments

3.04 FIELD QUALITY CONTROL

- A. Clean, inspect, test, and energize Switchboards in accordance with applicable NECA / NEIS standards and recommendations.
- B. Verify circuit breakers are in the proper locations and that setting of trip units, devices and current sensor taps match values scheduled on the approved shop drawings.
- C. Exercise each circuit breaker three (3) times to verify smooth mechanical operation.
- D. Verify proper torque of accessible bus connections and mechanical fasteners after installing Switchboards.
- E. Field testing shall be done in accordance with the requirements specified in Specification Sections:
 - 2. 26 00 10 – TESTING AND COMMISSIONING OF ELECTRICAL SYSTEMS
 - 3. Coordinate inspections and tests as required
- F. After completing installation, cleaning, and testing, touch up scratches and mars on finish to match original finish.
- G. Provide the services of a qualified factory-trained manufacturer's representative to provide start-up of the equipment specified under this Section for a period of three (3) working days.
- H. The Contractor shall provide three (3) copies of the manufacturer's field startup report.

3.05 TRAINING

- A. Contractor shall provide a training session for up to five (5) Owner's representatives for two (2) normal workdays at a job site location determined by the Owner.
- B. Training sessions shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers, and major components within the assembly.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish and install panelboards of voltage and current ratings as shown in the Contract Documents. Panelboards shall be furnished with circuit breaker ratings, number of breakers, number of poles and locations conforming to the panelboard schedules in the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this Section, the requirements of Division 26 and those Project Specification Sections referenced therein shall be applied.
- B. Related Specification Sections include but not limited to:
 - 1. 26 43 00 – SURGE PROTECTIVE DEVICES – 600V

1.03 REFERENCES

- A. Panelboards shall conform to all applicable Federal, UL, and NEMA standards. Materials and components shall be new and conform to grades, qualities and standards as specified herein and shown in the Contract Documents.
- B. Codes and Standards:
 - 1. UL Listing/ Approval
 - 2. UL 50 – Cabinets and Boxes
 - 3. UL 67 – Panelboards
 - 4. NEMA – PB1
 - 5. NFPA 70 – National Electrical Code

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per the Contract Specifications.
- B. Qualifications
 - 1. For approval, manufacturer shall have specialized in the manufacturing and assembly of Panelboards for at least fifty (50) years.

2. Furnish products listed by Underwriters Laboratories Incorporated and in accordance with standards listed in Section 1.3.
3. Manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
4. Equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
5. Switchboards shall bear a UL 891 label.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Panelboards and all components shipped loose shall be handled and stored in accordance with manufacturer's instructions and recommendations as outlined in applicable Installation and Maintenance Manuals. Three (3) copies of these instructions shall be included with the equipment at time of shipment.
- B. Inspect and report concealed damage to carrier within their required time period. Owner is not responsible for damages incurred during shipping, handling and storage.
- C. Store in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect structure from dirt, water, construction debris, and traffic. Where applicable, provide adequate heating within enclosures to prevent condensation.

1.06 OPERATION AND MAINTENANCE MANUALS

- A. Panelboards operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

1.07 WARRANTY

- A. Manufacturer shall warrant Panelboards to be free from defects in materials and workmanship for the lesser of one (1) year from date of installation or eighteen (18) months from date of purchase.

1.08 IDENTIFICATION

- A. Panelboards shall be identified with the equipment tag number indicated on the Contract Documents and the accepted shop drawings. Nameplates shall be furnished and installed as required Specification Section(s):

1. 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Panelboards shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown in the Contract Documents.
- B. Subject to compliance with the Contract Documents all Panelboards shall be of the same manufacturer and provided by:
 - 1. Eaton Power and Industrial
 - 2. Square D / Schneider Electric USA
 - 3. Approved Equal

2.02 MAIN BUS AND BRANCH CONNECTORS

- A. All main bus shall be copper sized in accordance with UL standards to limit the temperature rise on any current carrying part to a maximum of 50C above a maximum ambient temperature of 40C.

2.03 PANELBOARDS - POWER DISTRIBUTION

- A. General
 - 1. Power Distribution Panelboards, as defined by NEC or noted in Contract Documents, shall be of the configuration and rated as shown in the Contract Documents. Panelboards shall be dead front type with automatic trip-free, non-adjustable, thermal overload branch circuit breakers. Circuit breakers shall be bolt-on molded case type conforming to NEMA Standard AB1. Trip elements of the circuit breakers shall be rated 20A unless otherwise shown in the Contract Documents. Bus ratings shall be as shown in the Contract Documents. Panelboards shall be listed and labeled by Underwriter's Laboratories, Inc.
 - 2. Power distribution panelboards shall be fully rated and shall have a short circuit rating of 35kA symmetrical, minimum. In the event the results of the Contractor's short circuit fault analysis, as accepted by the Engineer, indicate that a higher short circuit rating of the panelboards is required, furnish complete panelboards with that higher rating.
 - 3. Power Distribution Panelboards shall be furnished with Surge Protective Device(s) (SPD) integral to the Panelboard provided by the Panelboard Manufacturer.
- B. Enclosures

1. Power Distribution Panelboard enclosure rating shall be NEMA Type-12 or as indicated in the Contract Documents. The door shall be fastened to the enclosure with concealed brass hinges and shall be equipped with flush-type catches and locks; all locks shall be keyed alike. Enclosures shall have wiring gutters on sides and shall be at least 20IN wide and 5-3/4IN deep. Contractor shall provide an engraved nameplate for the panelboard in accordance with Section 1.8
2. All metal surfaces of the enclosures shall be thoroughly cleaned and given one prime of zinc chromate primer. All interior surfaces shall then be given one shop finishing coat of a lacquer of the nitro cellulose enamel variety. All exterior surfaces shall be given three coats of the same lacquer. The color of finishing coats shall be light gray ANSI #61.
3. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the cabinet.

C. Bus Work

1. Main bus bars shall be of ample size so that a current density of not more than 1kA per square inch of cross section will be attained. This current density shall be based on the application of the full load connected to the panel plus approximately 25% of the full load for spare capacity. The main bus shall be full capacity as based on the preceding for the entire length of the panel so as to provide full flexibility of circuit arrangement.
2. Solid neutral bus bars, where required, shall be provided. Ratings shall be in accordance with applicable standards.
3. A separate ground bus shall be provided with lugs for termination of equipment grounding conductors.
4. Branch bus work shall be rated to match the maximum branch circuit breaker which may be installed in the standard space.
5. All bus shall be plated copper.

D. Circuit Breakers

1. Circuit breakers shall be 100% rated, bolt-on, molded-case type conforming to NEMA Standard AB 1. Trip elements of circuit breakers shall be 20A unless otherwise shown in the Contract Documents. Minimum branch circuit breaker shall be 100A frame for 30A and above except where shown otherwise in the Contract Documents or where a larger frame size is standard for the continuous current rating required. Breakers shall have an interrupting rating of 35kA symmetrical at 480VAC, minimum. All breakers shall have quick-make, quick-break, toggle mechanism for manual as well as automatic operation. Tandem or half-size breakers are not acceptable.

E. Directories

1. Approved directories with glass or noncombustible plastic cover, and with typewritten designations of each branch circuit, shall be provided in each panel. Contractor shall maintain in each panel, during the duration of the Contract, a handwritten directory clearly indicating the circuit breakers in service. This directory shall be updated as work progresses, and final, typewritten directories, as specified above, shall be installed at the end of the project and required for project close-out. Designations and circuit locations shall conform to the Panelboard schedules in the Contract Documents, except as otherwise authorized by the Engineer.
2. Contractor shall provide directories identifying Panelboards and indicating the size of the feeder (cable and conduit) serving the panel, circuit numbers, and a description of associated branch circuits including branch circuit trip and connected load for each circuit.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Panelboards shall be furnished and installed as shown in the Contract Documents and as recommended by the equipment manufacturer.
- B. Panelboards shall be set true and plumb in all locations as shown in the Contract Documents. Top of Panelboard enclosure shall not exceed 6FT above finished floor elevation.
- C. Panelboards installed outdoors shall not be mounted to hand-rail or safety rail.
- D. Panelboard enclosures shall not be fastened to concrete or masonry surfaces with wooden plugs, conical plastic anchors. Appropriate cadmium plated or galvanized steel bolts shall be used with expansion shields or other metallic type concrete insert for mounting on concrete or solid masonry walls. Cadmium plated or galvanized steel toggle bolts shall be used for mounting on concrete block or other hollow masonry walls. Bolt diameter shall be as required considering the size and weight of the completed panelboard and enclosure to provide adequate structural support.
- E. Contractor shall not use factory furnished knockouts with surface back boxes. The Contractor shall punch or drill required openings during installation and shall equip flush back boxes with manufacturer's standard pattern of knockouts. The Contractor shall equip enclosure doors exceeding 40IN height with vertical bolt three-point locking mechanism.
- F. Contractor shall install cabinets (and other enclosure products) in plumb with the building construction. Flush enclosures shall be installed so that the trim will rest

against the surrounding surface material and around the entire perimeter of the enclosure.

3.02 PROJECT CLOSE OUT

- A. All exterior and interior surfaces of the Panelboards shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same paint coating as approved by the manufacturer for touch-up work.
- B. Interiors of Panelboards shall be free of debris to include cleaning of wire/cable pulling compounds. The use of compressed air systems is not acceptable.

END OF SECTION

SECTION 26 24 19 – LOW-VOLTAGE MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish labor, material, equipment, related services, and supervision required, including, but not limited to, installation and configuration for Low-Voltage Motor Control Centers and/or Low-Voltage Intelligent Motor Control Centers. Provide Tesys T Motor Management system with Ethernet IP communication. Provide all control power necessary and section for Allen Bradley CPU gateway including power supply and Ethernet Switch connection to Tesys-T. Control voltage shall be 24VDC unless otherwise shown. CPU gateway by others, herein referred as MCC and iMCC respectively as shown in the Contract Drawings and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this Section, the requirements of Division 26 and those Project Specification Sections referenced therein shall be applied.
- B. Related Specification Section(s) include but not limited to
 - 1. 26 00 05 – SHORT-CIRCUIT COORDINATION AND ARC-FLASH ANALYSIS
 - 2. 26 43 00 – SURGE PROTECTIVE DEVICES-600V

1.03 REFERENCES

- A. Publications listed below form a part of this Specification Section to the extent referenced. Publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the most current latest date as related to the Contract, unless otherwise specified.
- B. Codes and Standards
 - 1. American National Standards Institute (ANSI)
 - a. C37.13 – Low Voltage Power Circuit Breakers
 - b. C37.17 – Trip Devices
 - c. C37.20.7 – Arc Resistant Testing
 - d. Z55.1 - Gray Finishes for Industrial Apparatus and Equipment

2. ASTM International (ASTM)
 - a. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
 - a. 519, Guide for Harmonic Control and Reactive Compensation of Static Power Converters
 - b. 1584, Guide for Performing Arc Flash Hazard Calculations
4. International Organization for Standardization (ISO)
 - a. 9001, Quality Management Systems – Requirements
5. National Fire Protection Agency (NFPA)
 - a. 70, National Electrical Code (NEC)
 - b. 70E, Standard for Electrical Safety in the Workplace
 - c. 79, Electrical Standard for Industrial Machinery
6. National Electrical Manufacturer Association (NEMA)
 - a. 250, Enclosures for Electrical Equipment
 - b. ICS 18, Motor Control Centers
7. USA Military Standard (MIL)
 - a. MIL-STD-202, Test Methods for Electronic and Electrical Component Parts
8. Underwriters Laboratories, Inc. (UL)
 - a. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations
 - b. 498, Standard for Attachment Plugs and Receptacles
 - c. 508, Standard for Industrial Control Equipment
 - d. 508A, Standard for Industrial Control Panels
 - e. 508C, Standard for Power Conversion Equipment
 - f. 845, Motor Control Centers

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per Specification Section(s)
 1. 01 33 00 – Shop Dwgs, Project Data and Samples

B. For Engineer Review

1. The following information shall be submitted to the Engineer
 - a. Drawing Index
 - b. Front, Side and Rear elevation views
 - c. Plan view of the assembly
 - d. Shipping section(s) weight(s)
 - 1) Section Center of Gravity (COG)
 - e. Completed Assembly weight
 - 1) Assembly Center of Gravity (COG)
 - f. Three-line diagrams
 - g. Schematic diagrams
 - h. Nameplate schedule
 - i. Component list
 - j. Conduit space locations within the assembly
 - k. Assembly ratings include but not limited to:
 - 1) Short-circuit rating
 - 2) Voltage
 - 3) Continuous current rating
 - l. Major component ratings include but not limited to:
 - 1) Voltage
 - 2) Continuous current rating
 - 3) Interrupting ratings
 - m. Cable terminal sizes
 - n. Seismic certification as specified
 - o. Arc Plenum and Arc Exhaust details
 - p. Product data sheets
2. Where applicable, the following additional information shall be submitted to the Engineer
 - a. Busway connection(s)
 - b. Composite front view and plan view of close-coupled assemblies

C. For Construction Review

1. The following information shall be submitted for record purposes

- a. Final as-built drawings and information for items listed in Section 1.4B, and shall incorporate all changes made during the manufacturing process
- b. Wiring diagram(s)
- c. Certified production test report(s)
- d. Installation information

D. Qualifications

1. For approval manufacturer shall have specialized in the manufacture and assembly of MCC for a minimum of fifty (50) years and iMCC for a minimum of twenty-five (25) years.
2. Furnish and install components, devices products and assemblies in accordance with standards listed in Section 1.3.
3. Manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
4. Equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
5. MCC and iMCC shall bear a UL 845 label.
6. All work performed and all materials used shall be in accordance with the NEC with applicable local regulations and ordinances. Process controllers, assemblies, materials, and equipment shall be listed and labeled by Underwriter's Laboratories or by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.05 DELIVERY, STORAGE AND HANDLING

- A. MCC and iMCC and all components shipped loose shall be handled and stored in accordance with manufacturer's instructions and recommendations as outlined in applicable Installation and Maintenance Manuals. Three (3) copies of these instructions shall be included with the equipment at time of shipment.
- B. MCC and iMCC section(s) shall be delivered in individual shipping splits for ease of handling. Sections shall be individually wrapped for protection and mounted on shipping skids as required to prevent tipping.
- C. Inspect and report concealed damage to carrier within their required time period. Owner is not responsible for damages incurred during shipping, handling and storage.
- D. Store in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect structure from dirt, water, construction debris, and traffic. Where applicable, provide adequate heating within enclosures to prevent condensation.

1.06 OPERATION AND MAINTENANCE MANUALS

- A. MCC and iMCC operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.
 - 1. Operation and Maintenance manuals, drawings etc. to be provided within the assemblies shall be water-proof and fire-resistant utilizing tear-resistant paper.

1.07 WARRANTY

- A. Manufacturer shall warrant MCC and iMCC to be free from defects in materials and workmanship for the lesser of one (1) year from date of installation or eighteen (18) months from date of purchase.

1.08 IDENTIFICATION

- A. MCC and iMCC shall be identified with the equipment tag number indicated on the Contract Documents and the accepted shop drawings. Nameplate(s) shall be securely affixed in a conspicuous place on MCC and iMCC. Nameplates shall be furnished and installed as required Specification Section(s)
 - 1. 26 00 15 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. MCC and iMCC shall be provided by one of the manufacturers listed
 - 1. Allen Bradley/Rockwell
 - 2. Eaton Power and Industrial
 - 3. General Electric Company
 - 4. Siemens Power USA
 - 5. Square D / Schneider Electric USA
 - 6. Approved Equal
- B. Listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting the Specifications in their entirety.
- C. Modifications or additions to existing MCC and iMCC shall be the same as the original manufacturer for model series still in production; otherwise the original manufacturer or an above listed acceptable manufacturer may provide these

modifications and assemblies with proof of prior experience furnishing these types of modifications.

2.02 RATINGS

- A. Voltage and Ampere ratings shall be as indicated in the Contract Documents. The entire assembly shall be suitable for 600VAC maximum service.
- B. MCC and iMCC shall be 600VAC class suitable for operation on three-phase, 60Hz system. MCC and iMCC and their components shall conform to the applicable requirements of NEMA ICS 18-2001 and UL-845.
- C. System operating voltage and number of wires shall be as shown in the Contract Documents
- D. MCC and iMCC shall be rated for an available short circuit capacity of 35kA RMS symmetrical minimum or as shown in the Contract Documents.
- E. MCC and iMCC shall be arc resistant to meet the requirements of ANSI C37.20.7 with Type-2 accessibility when protected by an upstream device with a maximum clearing time of 50mSEC, the internal arcing event is device limited, the maximum short circuit current is 35kA RMS symmetrical, and the arc duration is equal to or less than 100mSEC.
- F. MCC and/or iMCC shall be provided as shown in the Contract Documents.

2.03 CONSTRUCTION

- A. Materials
 - 1. Steel material shall comply with UL 845 and CSA requirements.
 - 2. MCC and iMCC shall consist of one or more vertical sections of heavy gauge steel bolted together to form a rigid, freestanding assembly. A removable seven-gauge (#7) structural steel lifting angle shall be mounted full width of the shipping block at the top. Removable seven-gauge (#7) bottom channel sills shall be mounted underneath front and rear of the vertical sections extending the full width of the shipping block. Vertical sections made of welded side-frame assembly formed from a minimum of twelve-gauge (#12) steel. Internal reinforcement structural parts shall be of twelve-gauge (#12) and fourteen-gauge (#14) steel to provide a strong, rigid assembly. The entire assembly shall be constructed and packaged to withstand normal stresses included in transit and during installation.
- B. Structures

1. The enclosure rating shall be NEMA-1G/12 or as otherwise indicated on the Contract Documents.
2. Totally enclosed, dead-front, freestanding assemblies; structure shall be capable of being bolted together to form a single assembly.
3. Overall section height shall not exceed 90IN, not including base channel or lifting angle, baffle, or plenum. Base channels of 1.5IN in height shall be provided. Lifting angles of 3IN in height shall be provided and shall be removable. Total minimum section width of one section shall be 20IN; section widths of 25IN, 30IN and 35IN may be used for larger devices or vertical wireways.
4. Standard section for draw-out type units shall have all the necessary hardware and bussing to add or move units within section. All unused space shall be covered by hinged blank doors. All space equipped to accept future units and include hinged blank doors. Vertical bus openings shall be covered by manual bus shutters.
5. Section shall include a top plate: single or two-piece. NEMA-12 sections shall also include a bottom plate. These plates shall be removable for ease in cutting conduit entry openings.
6. Provide a glass polyester full height and depth barrier between adjacent vertical structures in the bus compartment with appropriate slots for horizontal and vertical bus.
7. Arc-Flash Resistance Ratings for MCC and iMCC as identified on the Contract Documents shall include but to limited to the following
 - a. Arc-Flash Resistance Rating shall be Type 2B as defined by ANSI C37.20.7. such that the operator is protected around entire perimeter of equipment with the low voltage control, instrumentation and breaker secondary customer termination compartment doors open.
 - b. MCC and iMCC shall be made compatible with new Arc-Flash Reduction Maintenance System or existing arc-flash mitigation control system.
 - c. Ventilation system that allows exhaust of arc gasses regardless of the origination location of the arc event. The ventilation system shall be designed to exhaust arc events originating in the breaker cell, motor controller cell, bus compartment, and cable compartments.

C. Wireways

1. Assemblies shall contain a minimum 12IN high horizontal wireway at the top of each section and a minimum 6IN high horizontal wireway at the bottom of each section. Wireways shall run the full length of section to allow room for power and control cable to connect between units in different sections.

2. A full-depth vertical wireway shall be provided in each section that accepts modular draw-out units. Vertical wireway shall connect with both the top and bottom horizontal wireway. Vertical wireway shall be 4IN or 9IN wide with a separate hinged door.
3. Access to the wireways shall not require opening control unit doors.
4. A steel barrier for communication cabling and I/O wiring shall be provided in each vertical wireway to provide separation from motor cables.

2.04 BUS

- A. All bus, connectors, splice plates, stabs, etc. shall be tin-plated copper.
- B. Main horizontal bus shall be rated at as shown in the Contract Documents continuous and shall extend the full length of the assembly. Bus ratings shall be based on 65C maximum temperature rise in a 40C ambient. Provisions shall be provided for splicing additional sections onto either end of the assembly.
- C. Horizontal bus splice bars stack shall be installed into the end of the power bus to allow the installation of additional sections. The main bus splice shall utilize four bolts, two on each side of the bus split, for each phase. Additional bolts shall not be required when splicing higher amperage bus. The splice bolts shall secure to self-clenching nuts installed in the bus assembly. It shall be possible to maintain any bus connection with a single tool.
- D. Assembly shall be fitted with insulated horizontal bus. Horizontal bus joints shall be covered by an insulating box consisting of tabs and slots which can be opened and closed without tools for ease of joint maintenance.
- E. Three-Phase Four-Wire (3PH/4W) systems must contain a neutral provision at the main incoming cable compartment. A neutral bus system shall be installed that is rated to 100% of the main bus rating up to 1600A. Neutral vertical bus must be provided in the main structure and in each in vertical section requiring a neutral connection.
- F. Sections that accepts plug-in units shall be provided with a vertical bus for distributing power from the main bus to the individual plug-in starter units. This bus shall be of the same material and plating as the main bus, and shall be rated at 300A continuous current.
- G. A tin-plated copper ground bus shall be provided that shall run the entire length of the assembly. Ground bus shall be 0.25IN by 2IN and shall be rated for 600A. Mechanical lugs shall be provided for four (4) 8AWG through 250kcmil ground cable. Ground bus shall be provided with six (6) 0.38IN holes for each vertical section to accept user-supplied ground lugs for any loads requiring a ground conductor.

2.05 UNIT CONSTRUCTION

- A. Units with circuit breaker disconnects rated less than or equal to 250A frame size and fusible switch disconnects rated less than or equal to 100A shall be available in a 6IN unit size. Stab-on plug-on units shall be cable connected to the unit disconnect.
- B. Units with circuit breaker disconnects rated up to 400A frame size, and fusible switch disconnects rated up to 400A, shall connect to the vertical bus through a spring reinforced stab-on connector. Units with larger disconnects rated above 400A shall be connected directly to the main horizontal bus with appropriately sized cable or riser bus.
- C. All conducting parts on the line side of the unit disconnects shall be shrouded by a suitable insulating material to prevent accidental contact with those parts.
- D. Unit mounting shelves shall include hanger brackets to support the unit weight during installation and removal.
- E. All plug-on units 12IN or greater shall use a twin-handle camming lever located at the top of the bucket to rack in and out the plug-on unit. Cam lever shall work in conjunction with the hanger brackets to ensure positive stab alignment.
- F. Lever handle operator shall be provided on each disconnect with the unit stabs engaged onto the vertical phase bus and the unit door closed, the handle mechanism shall allow complete ON/OFF control of the unit. All circuit breaker operators shall include, but shall not be limited to a separate TRIPPED position to clearly indicate a circuit breaker trip condition. Unit shall allow resetting of a tripped circuit breaker without opening the control unit door. Clear indication of disconnect status shall be provided, by adhering to the following operator handle positions
 1. ON position shall be up or to the left and within 45-degrees of being parallel to the face of the equipment.
 2. OFF position shall be down or to the right and within 45-dgrees of being parallel to the face of the equipment.
 3. Minimum separation between ON and OFF positions shall be 90-dgrees.
 4. TRIPPED position shall be perpendicular to the face of the equipment ± 30 -dgrees.
- G. A mechanical interlock shall prevent the operator from opening the unit door when the disconnect is in the ON position.
- H. A non-defeatable interlock shall be provided to prevent installing or removing a plug-on unit unless the disconnect is in the OFF position.

- I. Plug-in unit shall have a grounded stab-on connector which engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors.
- J. Units shall be provided for locking all disconnects in the OFF position with up to three padlocks.
- K. Units shall be provided with unit control screw-cage terminal blocks. Terminal blocks shall be pull-apart type, 250V rated for 10A. Current-carrying parts shall be tin-plated. Terminals shall be accessible from inside the unit when the unit door is opened. Stationary portion of the terminal block shall be used for factory connections and shall remain attached to the unit when the portion used for field connections is removed. Terminals used for field connections shall be accessible so they can be wired without removing the unit or any of its components.
- L. Surfaces (back, side, and bottom plates) of the unit interior shall be painted white.

2.06 TYPICAL COMPONENTS FOR UNITS

A. General

- 1. All motor controller units shall use a unit disconnect switch as described in Section 2.5
- 2. All unit components shall be NEMA rated.
- 3. Control Power Transformers (CPT) shall include two primary protection fuses and one secondary fuse (in the non-ground secondary conductor). CPTs shall be sized to accommodate the contactor(s) and all connected control circuit loads to include all motor accessories such as motor space heaters. CPT rating shall be fully visible from the front when the unit door is opened.
- 4. Whenever a CPT is not provided, the disconnect shall include an electrical interlock for disconnection of externally powered control circuits.
- 5. Motor Controllers NEMA Sizes 1 through 4 shall be mounted directly adjacent to the wireway so that power wiring (motor leads) shall connect directly to the starter terminals without the use of interposing terminals. Larger Motor Controllers shall be arranged so that power wiring may exit through the bottom of the starter cubical without entering the vertical wireway.

B. Terminal Blocks:

- 1. When Type B wiring is specified, Motor Controller units shall be provided with screw-cage terminal blocks.
- 2. Terminal blocks shall be the pull-apart, screw-cage type with a minimum rating of 250V and 10A. All current carrying parts shall be tin-plated. Terminals shall be accessible from inside the unit when the unit door is opened. Terminal blocks shall be DIN rail-mounted with the stationary

portion of the block secured to the unit bottom plate. Stationary portion shall be used for factory connections, and shall remain attached to the unit when removed. Terminals used for field connections shall face forward so they can be wired without removing the unit or any of its components.

3. When Type C wiring is specified, all starter units shall be provided with unit control screw-cage terminal blocks as described for Type B wiring along with power screw-cage terminal blocks for Motor Controllers NEMA Sizes 1 through 3. An additional set of screw-cage terminal blocks shall be provided in a terminal compartment located in each section. These terminal blocks shall be pre-wired to the unit terminals so that all field control connections can be made at the terminal compartments.

C. Pilot Device Panel

1. Units shall be provided with a hinged/removable control station plate, which can accommodate a minimum of three (3) LED pilot devices. The control station plate may be deleted if no local pilot devices are required.
2. LED pilot lights shall be mounted on the control station plate, for indication of the following status (minimum)
 - a. Power ON / Controller READY pilot light, LED, BLUE
 - b. RUNNING pilot light, LED, GREEN, push-to-test
 - c. STOPPED pilot light, LED, RED, push-to-test.
 - d. HAND / AUTO pilot lights, LED, AMBER, push-to-test
 - e. FAULT(S) pilot light, LED, AMBER, push-to-test
 - f. Additional pilot lights shall be installed as required in accordance with the Contract Documents
3. Devices shall be (30mm), NEMA Type 4/13

2.10 MAIN AND FEEDER MOLDED CASE CIRCUIT BREAKERS (MCB)

- A. Molded Case Circuit Breakers (MCCB) shall have voltage and interrupting ratings that meet the application requirements. Interrupting rating shall be available up to 200kAIR without fuses.
- B. MCCB with 100A to 600A frame ratings shall be made with a double rotary contact to limit let-through energy on the installation
- C. MCCB with 100A to 400A frame rating shall be equipped with thermal magnetic trip units.
- D. MCCB with 250A frame ratings and higher, shall be fitted with metallic filters to reduce effects perceptible from the outside during current interruption.

- E. MCCB with frame ratings larger than 400A shall be equipped with electronic trip units.
- F. MCCB shall be designed to trip the circuit breaker in the event of high-level short-circuit currents. Design shall be independent of the thermal-magnetic or electronic trip unit.
- G. P and R-frame circuit breakers shall be equipped with a safety interlock which keeps the circuit breaker open if the trip unit is not installed.
- H. Electronic Trip Units (frame ratings larger than 400A)
 - 1. Electronic Trip Unit (ELTU) shall be true RMS sensing.
 - 2. ELTU shall have the capability to electronically adjust the settings locally and remotely to fine increments below the switch settings. Fine increments for pickup adjustments shall be 1A. Fine increments for delay adjustments shall be 1SEC.
 - 3. ELTU shall be available to provide real time metering. Metering functions shall include, but shall not be limited to, the following
 - a. Current (phases, neutral, average, maximum)
 - b. Voltage (phase-to-phase, phase-to-neutral, average, unbalance)
 - c. Power (active [kW], reactive [kVAR], apparent [kVA], power factor)
 - d. Energy (active [kWh], reactive [kVAR], apparent [kVA])
 - e. Total harmonic distortion (current, voltage)
 - f. Metering accuracy shall be 1.5% current (above 600A), 1.0% current (600A and below), 0.5% voltage, and 2% energy. This accuracy shall be total system, including, but not limited to, CT and meter.
- I. Thermal Magnetic Trip Units (frame rating less than or equal to 400A)
 - 1. Thermal Magnetic Trip Unit (TMTU) shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 40C ambient temperature.
 - 2. Circuit breaker frame sizes 250A and above shall have a single magnetic trip adjustment located on the front of the circuit breaker
 - 3. Where indicated in the Contract Documents, circuit breakers shall be equipped with a ground fault module (GFM) with 20A to 200A sensitivity level or earth leakage module (ELM) with sensitivity ranges between 30 mA and 3A, or approved equivalent.
- J. Arc-Flash Reduction System (ARS)
 - 1. Main Circuit Breakers (1200A frame and higher), provide an Arc-Flash Reduction System (ARS) selector switch on the compartment door to

- switch the circuit breaker instantaneous tripping characteristics to an alternate setting temporarily during maintenance activity.
2. Provide a lock feature for the ARS switch so that it may be locked in either the OFF or ON maintenance mode position.
 3. Provide a BLUE, LED pilot light (push-to-test) that indicates when the trip unit is in the ARS mode.
 4. Wire contacts on all ARS switches to a common alarm input to SCADA system using interposing relay(s).

2.11 POWER METERING

- A. Provide power meter for each MCC and iMCC Main Incoming Feeder Section as shown in Contract Documents and as follows
 1. Low-Voltage Mains: Metering device used to monitor the Low-Voltage Mains for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall be provided and installed by MCC and iMCC manufacturer.
 2. High-visibility color graphical display.
 3. Direct connect to circuits up to 600VAC, eliminating the need for voltage (potential) transformers; four (4) metered 5A nominal current inputs for three-phase measurements plus neutral.
 4. Supported monitoring parameters — full range of three-phase voltage, current, power, and energy measurements, total harmonic distortion (THD), individual current and voltage harmonics readings, waveform capture, voltage and current disturbances (dip/swell) detection, ability to determine the location of a disturbance (upstream or downstream).
 - a. Disturbance direction – provide an indication of the location of each power system event as up-stream or down-stream along with the level of confidence of the location.
 5. Power Quality compliance — without using separate software, determine statistical indicators of power quality that include but are not limited to voltage dips and swells, harmonics, and frequency in accordance with EN 50160 power quality standard and provide an indication of pass/fail in a web interface; Third party laboratory tested to the power quality standard IEC 61000-4-30 Class 'S'.
 6. User customization — capable of deriving values for any combination of measured or calculated parameters using arithmetic, trigonometric, and logic functions through graphical, flexible object oriented, programmable modules. Modules can be linked together in an arbitrary manner to create functionality such as totalization, efficiency measurements, control functions, load shedding, demand response, power factor correction, and compliance monitoring.

7. Communications capability — multi-port Ethernet and serial communications with at least two (2) Ethernet ports and one (1) RS485 serial port. Functionality through Ethernet connectivity includes email on alarm, email interval energy data, on-board web server, SNMP network management, NTP time synchronization, Ethernet-to-serial RS-485 gateway, Modbus, DNP3, and IEC 61850.
8. On-board logging: non-volatile time stamped on-board logging of input/output (I/O) conditions, minimum and maximum values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand; custom alarming with time stamping in which the meter has the capability of learning set-point limits based on the system behavior; trigger alarms on at least fifty (50) definable power or I/O conditions; use of Boolean logic to combine alarms.
9. I/O — provide at least three (3) digital inputs and one (1) digital output for equipment status/position monitoring and equipment control or interfacing with millisecond timestamp. Meter shall accept up to four (4) field installable I/O modules. Provide additional modules as required for application. Each digital I/O module shall provide six (6) digital status/counter inputs and two (2) Form-C relay outputs rated at 250V, 8A. Each analog I/O module shall provide four (4) inputs configurable to 4-20mA or 0-30V ranges and two (2) outputs configurable to 4-20mA or 0-10V ranges.

2.12 ETHERNET COMMUNICATIONS

A. General Requirements

1. Where specified or shown in the Contract Documents MCC and iMCC shall be provided with industrial quality managed Ethernet switch(s) as required to communicate and perform the functions necessary for connection to an industrial communications network. In conjunction with the Ethernet switches a communications network shall be provided within the MCC and iMCC to connect all Ethernet communications capable equipment within the assemblies. In addition, the following components shall be provided with Ethernet connections for communications over the network
 - a. Incoming Mains Power Meter(s)
 - b. Main Circuit Breaker(s)
 - c. Feeder Circuit Breakers as designated in the Contract Documents
 - d. Motor Starters or associated Intelligent Motor Protection Relays
 - e. Variable Frequency Drives
 - f. Reduced Voltage Solid-State Starters
2. Ethernet network communications architecture shall form a star topology to optimize network availability and reliability. Star topology is created by way

of home run patch cables individually run from each communicating motor starter or circuit breaker unit back to a centrally located Ethernet Switch unit.

3. Minimum of two (2) managed Ethernet switches shall be provided per MCC and iMCC. Ethernet switch connections to equipment for multiple loads of a single process train shall be evenly split between switches so that a switch failure will not disable all communication to all equipment within that process train.
4. MCC and iMCC with a main-tie-main configuration shall be provided with an Ethernet switch and associated power section on either side of the tie. Each section shall be fully operable independent of state of the switch on the other side of the tie.
5. Additional network communication requirements as depicted on the Contract Documents.

B. Managed Ethernet Switches

1. Subject to compliance with requirements, provide Ethernet TCP/IP Managed Switch(es) 3rd party manufacturer.
2. Managed switches shall provide capability for prioritization of network traffic, Rapid Spanning Tree Protocol (RSTP), network redundancy, and Simple Network Management Protocol (SNMP).
3. MCC and iMCC shall contain two or more Ethernet switch devices with a sufficient quantity of RJ-45 ports for all communicating units, management ports, uplink ports, and approximately 10% spares.
4. All Ethernet switches shall be centrally mounted in a compartmentalized unit(s) for easy and ready access for troubleshooting without the presence of control power voltages greater than 24VDC.
 - a. Ethernet Switches shall be unit mounted and centrally located near the bottom of the assembly to optimize cable runs across shipping splits. Individually mounting Ethernet switches in horizontal or vertical wireways or behind wireway barriers that require maintenance personnel to work around or near exposed power cables is strictly prohibited. Ethernet Switch units shall be provided with cable supports which help to prevent stress and damage to Ethernet switch ports.
5. Switch compartments shall have no voltage over 24VDC

C. Communications Equipment Power Supply

1. An externally mounted, 24VDC power supply unit shall provide power to Ethernet switch unit(s) in order to prevent personnel exposure unsafe voltages.

D. Communication Cabling

1. The full-depth vertical wireway shall contain a communications barrier that will serve to separate communications from power cabling to prevent noise interference and mechanical damage on the network cables. Intermediate Ethernet connectors used to extend CAT6e cables through metal barriers may create additional points of failure, and are strictly prohibited.
2. MCC and iMCC shall employ industrial grade, shielded 600V rated Category 6e communication patch cables to interconnect communicating units with Ethernet switch units.
3. Subject to compliance with requirements, provide Cat6 Ethernet cables assemblies by Belden or equal as manufactured by 3rd party manufacturer.

E. Configuration protocol

1. MCC and iMCC shall communicate Ethernet/IP.

F. A startup/commissioning Network Validation Service shall be provided with each iMCC to reduce installation, commissioning and setup time on site. Training shall be provided as part of the service. This service shall be performed by a qualified services engineer.

2.13 NAMEPLATES

- A. Engraved nameplates, mounted on the face of all MCC and iMCC, shall be furnished as indicated in the Contract Documents; reference Section 1.8.
- B. Furnish master nameplate giving MCC and iMCC designation, voltage ampere rating, short-circuit rating, and manufacturer's name.
- C. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's drawings.

2.14 FINISH

- A. All exterior and interior steel surfaces of MCC and iMCC shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish shall be ANSI 61.

2.15 SPARE PARTS AND ACCESSORIES

- A. Provide manufacturer recommended spare parts for each type of motor controller unit to include consumable items for maintenance procedures.

2.16 SURGE PROTECTIVE DEVICES

City of Clearwater

**NE WRF MCC-1, DC1 & 2 REPLACEMENT
17-0028-UT
00992-0254**

**Low-Voltage Motor Control Centers
26 24 19-16**

- A. Provide surge protective devices as indicated on Contract Documents and as specified in Specification Section(s)

- 1. 26 43 00 –SURGE PROTECTIVE DEVICES 600V

PART 3 - EXECUTION

3.01 COORDINATION

- A. Contractor shall coordinate the MCC and/or iMCC installation(s) in accordance with the approved equipment submittals.
- B. MCC and/or iMCC shall be installed in accordance with the Electrical Raceway Systems design and best practices of the trade as complete assemblies as intended on the Contract Documents.

3.02 INSTALLATION

- A. Contractor shall install MCC and iMCC per the manufacturer's recommendations and the Contract Documents.
- B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.
- C. MCC and iMCC shall be installed and checked in accordance with the manufacturer's recommendations. This shall include but not limited to
 - 1. Checking to ensure that concrete flooring and/or concrete equipment pad(s) are level to within 0.125IN per 3FT feet of distance in any direction; reference Section 2.3B
 - 2. Checking to ensure that all bus bars are torqued to the manufacturer's recommendations
 - 3. Assembling all shipping sections, removing all shipping braces and connecting all shipping split mechanical and electrical connections
 - 4. Securing MCC and iMCC to concrete flooring and/or concrete equipment pad(s).
 - 5. Inspecting and installing all circuit breakers in their proper compartments

3.03 FIELD QUALITY CONTROL

- A. Clean, inspect, test, and energize MCC and iMCC in accordance with applicable NECA / NEiS standards and recommendations.
- B. Field testing shall be done in accordance with the requirements specified in Specification Section(s)

2. 26 00 10 – TESTING AND COMMISSIONING OF ELECTRICAL SYSTEMS
 3. Coordinate inspections and tests as required
- C. After completing installation, cleaning, and testing, touch up scratches and mars on finish to match original finish.
 - D. Provide the services of a qualified factory-trained manufacturer's representative to provide start-up of the equipment specified under this Section for a period of three (3) working days.
 - E. Contractor shall provide three (3) copies of the manufacturer's field startup report.

3.04 FACTORY ACCEPTANCE TESTING

- A. All MCC and iMCC shall go through a witnessed, at the discretion of the Owner or Engineer, Factory Acceptance Test (FAT) prior to shipment. FAT shall include, but not limited to, the following:
 1. Physical Inspection of the following
 - a. Structure
 - b. Electrical conductors, including, but not limited to, the following:
 - 1) Bussing
 - 2) General wiring
 - 3) Units
 2. Electrical Tests
 - a. General electrical tests shall include, but shall not be limited to, the following:
 - 1) Power circuit phasing
 - 2) Control circuit wiring
 - 3) Instrument transformers
 - 4) Meters
 - 5) Ground fault system
 - 6) Device electrical operation
 - b. AC dielectric tests shall be performed on the power circuit.
 3. Markings/labels include, but shall not be limited to, the following
 - a. Instructional type
 - b. UL/CSA

- c. Inspector's stamps
- 4. Each device shall be configured and addressed to correspond with software settings.
- 5. A read/write test shall be performed prior to shipment on network devices, including, but not limited to, overloads, drives, and soft starters.
- 6. Testing shall be designed to verify system operation and shall include, but shall not be limited to, these verifications as a minimum
 - a. Drawings and bill of materials
 - b. I/O addressing
 - c. Correct device operation by I/O address
 - d. Host communications
 - e. Control network interface
- B. Manufacturer shall use integral quality control checks throughout the manufacturing process to ensure that the MCC and iMCC meet operating specifications.
- C. A certified test report of all standard FAT procedures, tests, results and corrective actions shall be shipped with MCC and iMCC.
- D. Manufacturer shall notify Engineer two (2) weeks prior to the date the tests are to be performed.

3.05 EXAMINATION

- A. Examine concrete flooring and/or concrete equipment pad(s) to receive MCC and iMCC for compliance with installation tolerances and other conditions affecting performance of the product as required by the manufacturers installation instructions and recommendations to include Engineer installation details. Do not proceed with installation until unsatisfactory conditions have been met or corrective action has been taken.

3.06 TRAINING

- A. Contractor shall provide a training session for up to five (5) Owner representatives for two normal workdays (2DY) at a job site location determined by the Owner.
- B. Training sessions shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers, and major components within the assembly.

3.07 PROJECT CLOSEOUT

3.08 ATTACHMENTS

END OF SECTION

SECTION 26 36 23 – AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install automatic transfer switches.
2. Switches specified under this Section include both open and enclosed types. Open type switches shall be factory tested and shipped to motor control center manufacturer for mounting and connection as specified in Section 26 24 19, Motor Control Centers.
3. Switch shall be provided with Bypass-Isolation Switch. Refer to Section 2.8.

B. Related Sections:

1. Section 26 00 15, Identification for Electrical Systems.
2. Section 26 24 19, Low Voltage Motor Control Centers.
3. Section 26 00 00, Electrical Basic Requirement

1.02 REFERENCES

A. Standards referenced in this Section are:

1. IEEE 472, Guide for Surge Withstand Capability Tests.
2. IEEE 446, Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications.
3. IEEE C62.41, Recommended Practice for Surge Voltages in Low Voltage AC Power Circuits.
4. NEMA ICS1 109, Tests and Procedures.
5. NEMA ICS10, AC Automatic Transfer Switches.
6. UL 1008, Transfer Switch Equipment.
7. UL 508, Industrial Control Equipment
8. UL 61010B-1 (previously UL 3111-1), Electrical Measuring and Test Equipment; Part 1: General Requirements.
9. ANSI C37.90a, Surge Withstand Capability Test (formerly IEEE Standard 472-1974) – Ring Wave Test.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:

1. NEC Article 700, Emergency Systems.
2. NEC Article 701, Legally Required Standby Systems.
3. NEC Article 702, Optional Standby Systems.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Listing of transfer switches to be provided, including ratings and location of each.
 - b. Equipment dimensions, and construction details of enclosures with conduit entry locations.
2. Product Data:
 - a. Manufacturer's technical information for products proposed, including catalog cut sheets.
3. Test Procedures:
 - a. At least thirty days prior to actual factory and field testing, submit proposed testing procedures, methods and apparatus.

B. Informational Submittals:

1. Source Quality Control Submittals:
 - a. Submit reports of completed factory tests, including test results and procedures used for testing.
2. Field Quality Control Submittals:
 - a. Submit reports of completed field tests, including test results and procedures used for testing.
3. Supplier Instructions:
 - a. Manufacturer's written instructions for transporting, handling, storing, and installing the products.
4. Supplier Reports:
 - a. Written report of each visit to Site by supplier's service representative.

C. Closeout Submittals

1. Operation and Maintenance Data:

- a. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation, and spare parts information.
- b. Manuals shall include record drawings of control schematics, including point-to-point wiring diagrams.
- c. Furnish operation and maintenance manuals per Section 01 78 23, Operations and Maintenance Data.

D. Maintenance Material Submittals: Furnish the following:

- 1. Spare Parts and Extra Stock Materials: Provide as specified in this Section.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices to be embedded in cast-in-place concrete in time to prevent delay of the Work.
- B. Shipping sections shall be designed to be shipped by truck, rail, and ship. Indoor sections shall be bolted to skids.
- C. Equipment shall be equipped to be handled by crane. Where cranes are not available equipment shall be suitable for skidding in place on rollers using jacks to raise and lower the sections.
- D. Comply with Section 01 65 00, Product Delivery Requirements, and Section 01 66 00, Product Storage and Handling Requirements.

PART 2 - PRODUCTS

2.01 SYSTEM PERFORMANCE

- A. Provide automatic transfer switches as specified for transferring loads from one power source to another.

2.02 MANUFACTURERS

- A. Manufacturers: Provide products of one of the following:
 - 1. ASCO Power Technologies.
 - 2. Russelectric, Inc.
 - 3. Or approved equal.

2.03 SWITCH

- A. Ratings:
 - 1. Switches shall be capable of switching all classes of loads and rated for continuous duty when installed in a non-ventilated enclosure.

2. Switches shall be rated with continuous ampere rating, number of poles and voltage as shown on Drawings.
3. Switches shall be rated to withstand the magnitude of fault current available without welding of contacts in compliance with ANSI C37.90a and IEEE C62.41.

B. Standards and Performance:

1. Switches shall comply with UL Standard 1008, NEMA Standard ICS10, and applicable requirements of NEC Article 700, IEEE 446, IEEE C62.41, UL 508, and UL 61010B-1. Switches shall be UL labeled with performance meeting or exceed the following:
 - a. Temperature Rise: Measurements shall be made after overload and endurance tests.
 - b. Withstand: UL listed to withstand magnitude of fault current available at switch terminals when coordinated with respective protective devices shown on Drawings at an X/R ratio of 6.6 or less. Main contacts shall not trip open or weld when subjected to fault currents.
 - 1) As a condition for approval, manufacturer of automatic transfer switches shall verify that switches are listed by Underwriters Laboratories, Inc., Standard UL-1008 with three-cycle short circuit closing and withstand as follows:

RMS Symmetrical Amperes at 480 VAC	
Amperes	3 Cycle Closing & Withstand (Minimum)
100 to 400	42,000
600 to 800	65,000
1000 to 1200	85,000
1600 to 4000	100,000

- 2) During three-cycle closing and withstand tests, there shall be no contact welding or damage. Three-cycle tests shall be performed without using current limiting fuses, and oscillograph traces across main contacts shall be furnished to verify that contact separation has not occurred, and there is contact continuity across all phases after completion of testing. Test procedures shall be in accordance with UL-1008, and testing shall be certified by UL.
 - 3) When conducting temperature rise tests to UL-1008, Supplier shall include post-endurance temperature rise tests to verify ability of transfer switch to carry full rated current after completing overload and endurance tests.
- c. Dielectric: Measurements shall be made at 1960 VAC RMS minimum following the withstand current rating test.

- d. Transient Withstand: Control panel shall pass the voltage surge withstand test per IEEE Standard 472 and voltage impulse withstand test per NEMA ICS1 109.
- e. ATS shall meet or exceed the withstand rating shown on the contract drawings

C. Construction:

- 1. Switch shall be double throw actuated by non-fused, momentarily energized operating mechanism(s).
- 2. Accomplish mechanical locking of main contacts in each direction without aid of latching solenoids, toggle mechanisms, or gear arrangements.
- 3. An overload or short-circuit shall not cause switch to go to a neutral position.
- 4. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
- 5. Switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
- 6. Main contacts shall be silver-tungsten composition. Switches shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
- 7. Inspection of contacts shall be possible from front of switch without disassembly of operating linkages and without disconnecting power conductors. Switches rated 600 amps and higher shall have front-removable and -replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors or bus bars.
- 8. Transfer switch shall be equipped with a safe manual operator designed to prevent injury to operating personnel. Manual operator shall provide same contact-to-contact transfer speed as electrical operator to prevent a flash-over from switching main contacts slowly. Manual operation shall be safe even if electrical operator becomes energized and shall not require prior disconnection of operators or control wiring. Safe manual transfer shall be possible under all load conditions, energized or non-energized. Manual operator shall be an external type, operable through door of transfer switch enclosure. Operating personnel shall not be required to open transfer switch door to facilitate manual transfer. Manual operator shall be functional at all times, regardless of switch position or status. Manually initiated electrical operation does not meet intent of this requirement. Manual operator is not required on closed transition type switches.
- 9. Neutral Connections:
 - a. Where indicated on the drawings switch shall include a solid neutral suitable for neutral conductors to be solidly connected. Provide neutral conductor plate with fully rated ALCU pressure connectors.

D. Enclosure: Enclosed switches shall be NEMA 1 at minimum.

1. Standard and optional door-mounted switches and pilot lights shall be LED type
 2. Provide door controls on a separate, removable plate that can be supplied loose for open type units.
- E. Identification: Identify switches per Section 26 05 53, Identification for Electrical Systems.

2.04 TRANSFER SWITCHING FEATURES

- A. Delay Transition (Open): Provide automatic delayed open transition transfer for each switch. Switch shall transfer load in delayed transition (break-before-make) mode. Transfer shall be accomplished with a user-defined interruption period in both directions adjustable from one second to five minutes in at least 15 increments.

2.05 SEQUENCE OF OPERATION

- A. When voltage on any phase of normal source is outside of specified parameters and after a programmable time delay period to allow for momentary dips, engine starting contacts shall close to start generating supply.
- B. Transfer switch shall transfer to emergency source when generating supply has reached specified voltage and frequency on all phases.
- C. After restoration of normal supply on all phases to within specified parameters, an adjustable time delay shall delay retransfer to normal to assure stabilization of normal supply. After expiration of the time delay period, transfer switch shall retransfer to normal. Should emergency supply source fail during the time delay period, switch shall bypass time delay and automatically return to normal source. Provide an adjustable time delay between opening of closed contacts and closing of open contacts during transfers to allow loads to be demagnetized.
- F. After retransfer to normal, engine generator shall be allowed to operate at no load for a programmable period to cool down.
- G. Should transfer to emergency source be initiated by test switch rather than an actual source failure, transfer from normal to emergency shall be as described above.

2.06 MICROPROCESSOR CONTROLLER

- A. Each switch shall include a microprocessor controller for operation of the switch. Equip controller with the following:
1. Provide controller's sensing and logic by a built-in microprocessor with ability to communicate serially through an optional serial communication module.

2. Controller shall provide a minimum of five selectable nominal voltages. Voltage sensing shall be true RMS type and be accurate to plus/minus one percent of nominal voltage. Frequency sensing shall be accurate to plus/minus 0.2 percent. Controller shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.
3. Connect controller to transfer switch by an interconnecting wiring harness that shall include a keyed disconnect plug to enable controller to be disconnected from transfer switch for routine maintenance. Interfacing relays shall be industrial grade plug-in type with dust covers. Enclose controller with a protective cover. Mount controller internally but separately from transfer switch.
4. Customer connections shall be wired to a common terminal block.

B. Controller Display and Keypad:

1. Display and keypad shall be an integral part of controller for viewing available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through serial communications input port. The following parameters shall be adjustable:
 - a. Nominal line voltage and frequency
 - b. Single- or three-phase sensing
 - c. Operating parameter protection
 - d. Transfer operating mode configuration: Open transition, closed transition or delayed transition
2. Instructions and controller settings shall be easily accessible, readable, and accomplished without using codes, calculations, or instruction manuals.

C. Controller Voltage, Frequency and Phase Rotation Sensing:

1. Voltage and frequency on both the normal and emergency sources shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities values shown as a percent nominal unless otherwise specified:

Parameter	Sources	Dropout/Trip	Pickup/Reset
Under-voltage	Normal and Emergency, three-phase	70 to 98%	85 to 100%
Over-voltage	Normal and Emergency, three-phase	102 to 115%	2% below trip
Under-frequency	Normal and Emergency	85 to 98%	90 to 100%
Over-frequency	Normal and Emergency	102 to 110%	2% below trip
Voltage Unbalance	Normal and Emergency	5 to 20%	1% below dropout

2. Repetitive accuracy of all settings shall be within plus/minus 0.5 percent over an operating temperature range of -20 degrees C to +60 degrees C.
3. Voltage and frequency settings shall be field adjustable in one percent increments, either locally with the display and keypad or remotely via serial communications port access.
4. When activated by keypad or through serial port, controller shall be capable of sensing phase rotation of both normal and emergency sources. Source will be unacceptable if phase rotation is not preferred rotation selected (ABC or CBA).
5. Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all three phases, frequency, and phase rotation.

C. Controller Time Delays:

1. Provide controller with time delays below. Time delay settings shall be adjustable over a range of zero to 9999 seconds (factory set at three seconds) unless specified otherwise.
 - a. Normal source failure, for engine starting.
 - b. Transfer to emergency on availability of emergency source.
 - c. Emergency source failure, retransfer on availability of normal source.
 - d. Engine cool down following retransfer to normal.
 - e. Time delay to control contact transition time during open transition transfer to either source.
 - f. All timers can be bypassed via operation on processor's keypad.
2. Provide adjustable time-delay on retransfer to normal. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable.
3. Provide a time delay activated output signal to drive external relays for selective load disconnect control. Controller shall have the ability to activate an adjustable zero to five-minute time delay for one of the following modes:
 - a. Prior to transfer only.
 - b. Prior to and after transfer.
4. Time delay and sensing functions shall be field adjustable and operate with drift that does not exceed plus/minus one percent of set frequency, plus/minus two percent of set voltage, and plus/minus ten percent of set time delay, over the temperature range of -20 degrees C to +70 degrees C.
5. Time delays shall be adjustable in one-second increments, except extended parallel time, that shall be adjustable in 0.01-second increments.
6. Time delays shall be adjustable by using display and keypad or with a remote device connected to serial communications port. Time delay value displayed shall be time remaining until next event occurs.

7. For (open) delay transition transfer switches controller shall include the following built-in time delays for delayed transition operation:
 - a. Zero to five-minute time delay for load disconnect position for delayed transition operation.

2.07 ACCESSORY FEATURES:

- A. Provide each switch with the following:
 1. A two-position maintained-type test switch for test/automatic/ modes. Test position shall simulate a normal source failure.
 2. A SPDT silver-tungsten contact, rated five amps at 30 VDC, for a low-voltage engine start signal. Start signal shall prevent dry cranking of engine by requiring generator set to reach proper output and run for duration of cool down setting regardless of whether normal source restores before load is transferred.
 3. Auxiliary contacts, rated ten amps at 250 VAC, consisting of one contact, closed when switch is connected to normal source and one contact closed when switch is connected to emergency source.
 4. LED indicating lights. One shall indicate when switch is connected to normal source (green) and one to indicate when the switch is connected to emergency source (red).
 5. LED indicating energized by controller outputs. Lights shall provide true source availability of normal and emergency sources as determined by voltage sensing trip and reset settings for each source.
 6. Provide the following built-in to controller, capable of being activated through keypad programming or serial port only when required by user:
 - a. Provide ability to select “commit/no commit to transfer” to determine whether load should be transferred to standby generator if normal source restores before generator is ready to accept load.
 - b. Provide terminals for a remote contact that opens to signal switch to transfer to emergency, and for remote contacts that open to inhibit transfer to emergency or retransfer to normal. Provide ability to activate both inhibit signals through keypad or serial port.
 - c. Controller shall be capable of accepting a normally open contact that will allow transfer switch to function in a non-automatic mode using an external control device.
 - d. Engine Exerciser: Controller shall provide an internal engine exerciser that allows user to program up to seven different exercise routines. For each routine, user shall be able to:
 - 1) Enable or disable routine.
 - 2) Enable or disable transfer of load during routine.
 - 3) Set start time.
 - 4) Time of day
 - 5) Day of week

- 6) Week of month (first, second, third, fourth, last, alternate, and every)
 - 7) Set duration of run.
 - 8) At end of specified duration, switch shall transfer load back to normal and run generator for specified cool down period. A ten-year life battery that supplies power to real time clock in event of a power loss shall maintain time and date information.
7. System Status: Controller display shall include a "System Status" screen that shall be readily accessible from all points in the menu by a maximum of two key strokes. System status screen shall display a clear description of active operating sequence and switch position.
 8. Self-Diagnostics: Controller shall contain a diagnostic screen for detecting system errors. Screen shall provide information on status input signals to controller that may be preventing completion of load transfer commands.
 9. Communications Interface: Controller shall be capable of interfacing, through an optional full-duplex RS 485 serial communication module, with a network of transfer switches, within 4,000 feet (locally) and remotely through modem serial communications. Standard software specific for transfer switch applications shall be available from transfer switch manufacturer. Software shall include monitoring, control, and setup of parameters.
 10. Data Logging: Controller shall have ability to log data and to maintain last 99 events, even during total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
 - a. Event Logging
 - 1) Date and time and reason for transfer normal to emergency.
 - 2) Date and time and reason for transfer emergency to normal.
 - 3) Date and time emergency source available.
 - b. Statistical Data
 - 1) Total number of transfers.
 - 2) Last ten numbers of transfers due to source failure.
 - 3) Total number of hours both normal and emergency sources are available.
 11. Terminate control wires with crimp lugs and identify with sleeve type markers. Provide suitable copper connector lugs for each service and load connections.

2.08 BYPASS-ISOLATION SWITCH

- A. Provide separate bypass and isolation handles. Handles shall be permanently affixed and operable without opening enclosure door. Designs requiring insertion

of loose operating handles or opening of enclosure door to operate are unacceptable.

- B. Bypass handle shall have three operating modes: “Bypass to Normal”, “Automatic”, and “Bypass to Emergency”. Operating speed of bypass contacts shall be the same as associated transfer switch and be independent of speed at which manual handle is operated. In “Automatic” mode bypass contacts shall be out of power circuit so that they will not be subjected to fault currents to which system may be subject.
- C. Isolation handle shall provide three operating modes: “Closed”, “Test”, and “Open”. “Test” mode shall allow testing of entire emergency power system, including automatic transfer switches with no interruption of power to load. “Open” mode shall completely isolate automatic transfer switch from source and load power conductors. In “Open” mode, it shall be possible to completely withdraw automatic transfer switch for inspection or maintenance to conform to code requirements without removing power conductors and without requiring tools.
- D. When isolation switch is in “Test” or “Open” modes, bypass switch shall function as a manual transfer switch.
- E. Make-before-break Design Bypass Isolation Switch:
 - 1. Make-before-break bypass isolation switch shall provide a means to manually bypass power from a dead source to a live source in event transfer switch (ATS) is disabled. Make-before-break bypass/isolation switch shall allow ATS to be isolated and de-energized for maintenance, testing, or repair without interrupting power to load if bypassed to source to which transfer switch is connected.
 - 2. Switch shall be able to bypass from normal to load, emergency to load, or to return from either bypassed position by paralleling source to which transfer switch is connected.
 - 3. When ATS is in normal position, bypass normal to load shall be accomplished. When ATS is in emergency position, bypass emergency to load shall be accomplished. Provide solenoid interlock to prevent bypassing to source that is not connected.
 - 4. By depressing solenoid interlock button and moving bypass handle to “Bypass” position, bypass contacts (BP) shall close, paralleling them with ATS contacts. After BP contacts are closed, mechanical interlocks shall immediately open load break contacts (LB), disconnecting load from transfer switch while maintaining power to load through BP contacts. This procedure shall be reversed when coming out of bypass; LB contacts shall be closed before BP contacts are opened, restoring power flow through ATS without power interruption.
 - 5. After ATS has been bypassed, power shall no longer flow through ATS but control power shall still be maintained to ATS controls. Complete operation testing capability shall be available, including transferring ATS from source to source without disturbing load.

6. After ATS has been bypassed, moving isolation handle to “Isolate” position simultaneously shall disconnect primary power and control power from ATS. Operation of isolation handle shall physically release transfer switch base. Transfer switch base shall be equipped with casters to enable removal of ATS from enclosure for inspection, maintenance, and repair. ATS shall be reinserted into connected position by moving isolation handle to “Normal” position, re-connecting both primary power and control power while maintaining power flow through bypass contacts. At this point, ATS shall be ready to come out of bypass.
7. Provide indicating lights to show the following:
 - a. Amber LED to indicate normal power available.
 - b. Amber LED to indicate emergency power available.
 - c. Green LED:
 - 1) Constant: Indicates load bypassed to normal source, isolating contacts closed, transfer switch energized.
 - 2) Flashing: Indicates load bypassed to normal source, isolating contacts open, transfer switch bypassed and isolated.
 - d. Red LED:
 - 1) Constant: Indicates load bypassed to emergency source, isolating contacts closed, transfer switch energized
 - 2) Flashing: Indicates load bypassed to emergency source, isolating contacts open, transfer switch bypassed and isolated.
8. Automatic transfer switch and bypass isolation switch shall be mounted in a common enclosure and be separated by barrier from each other. Provide separate hinged doors with individual lockable handles for transfer switch section and bypass switch section.
9. To facilitate safe and easy removal of transfer switch for maintenance and repair, transfer switch shall be of draw-out design. Draw-out shall be via draw-out carriage that disconnects all power and control connections from transfer switch so that switch is completely isolated and electrically de-energized.
10. Interconnections between transfer switch and bypass isolation switch shall be made by manufacturer so that installer shall be required only to make external power and control connections to lugs or terminal strips at bypass/isolation switch to complete installation. Power interconnections shall be silver-plated copper bus bar.

2.09 DATA MONITOR

- A. Provide a data monitor for each switch to monitor all functions specified. Flush-mount monitor on switch enclosure and equip monitor with continuous duty, long-life, lit display.
- B. Data monitors shall be rated for an operating temperature range of -20 degrees C to +60 degrees C.
- C. Data monitor shall be accurate to one percent measured, two percent computed values and display resolution to 0.1 percent. Voltage and current for all phases shall be sampled simultaneously to assure high accuracy in conditions of low power factor or large waveform distortions (harmonics).
- D. Data monitor shall be capable of operating without modification at nominal frequencies of 45 to 66 Hertz and over a control power input range of 20 to 32 VDC.
- E. Data monitor shall accept inputs from industry standard instrument transformers, including five-amp secondary current transformers. Direct-phase voltage connections, 600 VAC and under, shall be possible without using potential transformers.
- F. Data monitor shall be applied in single, three-phase, or three- and four-wire circuits.
- G. Setup parameters required by data monitors shall be stored in non-volatile memory and retained during control power interruption.
- H. Metered readings listed below shall be available from display and transmitted remotely by serial communications module. Transmit data in format compatible with plant monitoring and control system.
 - 1. Current, per phase RMS.
 - 2. Current unbalance percentage
 - 3. Voltage, phase-to-phase, and phase-to-neutral
 - 4. Voltage unbalance percentage
 - 5. Real power (KW), per phase and three-phase total
 - 6. Apparent power (KVA), per phase and three-phase total
 - 7. Reactive power (KVAR), per phase and three-phase total
 - 8. Power factor, three-phase total and per phase
 - 9. Frequency.
 - 10. Accumulated energy, (MWH, MVAH, and MVARH)
- I. The following energy readings shall be communicated by data monitor:
 - 1. Accumulated real energy (KWH)
 - 2. Accumulated reactive energy (KVAH)
 - 3. Accumulated apparent energy (KVARH)
 - 4. Real and reactive energy reported values for the load circuit.

- K. Provide menu scroll buttons to display data monitor quantities.
- L. Display shall remain continuously on, without detrimental effect on life of data monitor.
- M. Setup for system requirements shall be via the front of data monitor. Setup provisions shall include:
 - 1. CT Rating: Five ampere secondary and primary rating equal to automatic transfer switch rating.
 - 2. System Type: Single, three-phase; three- and four-wire.
 - 3. Communication parameters
- N. Provide capability to reset the following electrical parameters front of data monitor:
 - 1. Real energy (MWH), apparent energy (MVAH), and reactive energy (MVARH).
 - 2. All reset and setup functions shall have a means for protection against unauthorized and accidental changes.

2.10 SOURCE QUALITY CONTROL

- A. Perform manufacturer's standard factory tests that shall include:
 - 1. Physical inspection and checking of components.
 - 2. Mechanical operation and device functional tests.
 - 3. Control operation and functionality tests.
 - 4. Primary, control, and secondary wiring hi-pot tests.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine conditions under which Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.
- B. Install equipment in accordance with Contract Documents and manufacturer recommendations.
- C. Securely fasten equipment to floors, walls, or other surfaces on which equipment will be mounted. Install freestanding switches on raised concrete pad at locations shown on Drawings. Install in accordance with manufacturer's recommendations.

3.03 FIELD QUALITY CONTROL

- A. Perform field testing and inspection of each automatic transfer switch. Testing and inspection shall be in accordance with manufacturer's recommendations and be performed by manufacturer's factory-trained representative, who shall inform OWNER and ENGINEER when equipment has been correctly installed. Do not energize equipment without permission of OWNER.

3.04 MANUFACTURER SERVICES

- A. Manufacturer Services:
 - 1. Manufacturer's factory-trained representative shall test the system as specified in Article 3.3 of this Section. Representative shall operate and test system in the presence of ENGINEER and verify that equipment conforms to requirements. These services shall be at least one eight-hour days at the Site. Including travel.
 - 2. Manufacturer's factory-trained representative shall adjust the system to initial settings specified in Article 2.6 of this Section.
 - 3. Representative shall revisit the Site as often as necessary until all deficiencies are corrected, prior to readiness for final payment.
 - 4. Provide services of manufacturer's factory-trained representatives to correct defective Work within 72 hours of notification by OWNER during the Correction Period specified in the General Conditions as amended by the Supplementary Conditions.
 - 5. Replacement parts or equipment installed during the Correction Period shall be equal to or better than the original.
- B. Training: Furnish services of qualified factory trained specialists from manufacturer to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of the products. Training requirements, duration of instruction, and other qualifications shall be in accordance with the Contract Documents.

END OF SECTION

SECTION 26 43 00 – SURGE PROTECTIVE DEVICES - 600V

PART 1 – GENERAL

1.01 REQUIREMENT SUMMARY

- A. Contractor shall furnish and install Surge Protective Device (SPD) equipment having the electrical characteristics, ratings and modifications as specified herein and as shown in the Contract Documents. At a minimum SPD's shall be installed on the power line side of all switchgear, switchboard, and panelboards. They shall be factory installed where possible.
- B. SPD equipment shall provide effective high-energy protection against transient surges, temporary over voltages, voltage swells and high-frequency noise attenuation for power, control and telephone/data circuits 1kV or less and as shown in the Contract Documents.
- C. SPD units and all components shall be designed, manufactured and tested in accordance with the latest applicable UL standards.
- D. SPD equipment installation shall conform to local code requirements and the National Electric Code (NEC).

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. In addition to the requirements specified in this section, the requirements of Division 26 and those Project Specification Sections referenced therein shall be applied.
- B. Related Sections include but not limited to:
 - 1. 26 00 10 – TESTING AND COMMISSIONING OF ELECTRICAL SYSTEMS
 - 2. 26 05 26 – GROUNDING AND BONDING
 - 4. 26 24 13 – SWITCHBOARDS
 - 5. 26 24 16 – PANELBOARDS

1.03 REFERENCES

- A. Abbreviations and Acronyms:
 - 1. EMI: Electromagnetic Interference
 - 2. NTRL: Nationally Recognized Testing Laboratory
 - 3. SCCR: Short Circuit Current Rating

4. SPD: Surge Protection Device
 - a. Type-I: Permanently connected between the secondary of the utility transformer and the line or load side of the service entrance overcurrent device and intended to be installed without an external overcurrent device.
 - b. Type-II: Permanently connected to the load side of the service entrance overcurrent device including branch circuit panels.
 - c. Type-III: Connected from the electrical service panel to the point of utilization with a minimum conductor length of 30 FT.
 - d. Type-IV: Component and/or component assemblies.
5. SVR: Suppressed Voltage Rating
6. TOV: Temporary Over Voltage
7. TVSS: Transient Voltage Surge Suppressor

B. Codes and Standards:

1. Institute of Electrical and Electronics Engineers (IEEE):
 - a. C62.41, IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits.
 - b. C62.43, IEEE Certified by NRTL as "Secondary Surge Arrestor"
 - c. C62.45, IEEE Guide for Surge Testing for Equipment Connected to Low-Voltage AC Power.
2. International Electrotechnical Commission (IEC):
 - a. 61024, Protection of Structures against Lightning.
3. National Electrical Manufacturers Association (NEMA):
 - a. LS-1 (1992), Low Voltage Surge Protection Devices
4. National Fire Protection Association (NFPA):
 - a. NFPA 70, National Electrical Code (NEC) Article 285.
5. Underwriters Laboratories, Inc (UL):
 - a. UL 1283, Electromagnetic Interference Filters
 - b. UL 1449, Surge Protective Devices

1.04 SUBMITTALS

- A. Contractor shall reference and provide all documentation for all Division 26 Sections as required per the Contract Specifications.
- B. For Engineer Review
 - 1. Contractor shall submit written copies of all inspection and test reports.
 - 2. Product Data: For each type of product indicated, include unit dimensions, weights, installation instructions, wiring details, rated capacities, operating characteristics, furnish specialties and accessories. Include the following data, information and/or documents:
 - a. Suppressed Voltage Rating
 - b. Symmetrical Fault Current Withstand Ratings
 - c. Provide independent third-party testing lab report indicating device is capable of surviving the specified number of 8x20mSEC waveforms Spectrum Analysis based on MIL-STD-220A test procedures between 50kHz and 200kHz verifying the device noise attenuation equals or exceeds 50dB at 100kHz
 - e. Survivability of multiple TOV events for Type-I and Type-II devices
 - 3. Product Certificates: SPD devices, signed by third-party NRTL testing agencies certifying compliance with the following standards:
 - a. ANSI / UL 1449 Third Edition 2007 Revision
 - b. IEEE C62.34 Secondary Surge Arrestor
 - c. NEMA LS-1 (1992) Low Voltage Surge Protective Devices
 - d. UL 1283 Standard for Electromagnetic Interference Filters
- C. Qualifications
 - 1. Third-Party testing lab or US Department of Labor/OSHA approved NRTL.
 - 2. Field Quality-Control test reports, including but not limited to the following:
 - a. Test procedures used. Include single impulse testing data that matches label rating, including fuses or upstream breaker.
 - b. Test results that comply with requirements.
 - c. Failed test results and corrective actions taken to achieve requirements.

1.05 OPERATION AND MAINTENANCE MANUALS

- A. Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.

- B. Operation and Maintenance Data: For each type or series of SPD devices to include emergency, operation and maintenance manuals.

1.06 WARRANTY

- A. Manufacturer shall provide a full ten-year (10YR) warranty from the date of installation against any SPD device part failure when installed in compliance with manufacturer's written instructions and any applicable national or local codes.

1.07 IDENTIFICATION

- A. All SPD devices shall be identified as specified in Section PART 3, EXECUTION.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following manufacturers:
 - 1. Square-D
 - 2. Advanced Protection Technologies Inc
 - 3. Eaton/ Cutler Hammer
 - 4. Innovative Technology
 - 5. Current Technology

2.02 SERVICE ENTRANCE SPD (TYPE-I)

- A. Surge Protection Device Description: Modular design with field-replaceable module with EMI filtering and the following features:
 - 1. The SPD unit tested at 200kA interrupting capacity (AIC).
 - 2. The SPD unit shall provide overvoltage protection as follows:
 - a. >1800 cycles at 180% of rated voltage to 0.7 OHM load
 - b. Test Report included
 - 3. Fabrication using bolted compression lugs for internal wiring.
 - 4. Utilizing copper bus bars and bolted connections to phase buses, neutral bus and ground bus.
 - 5. Utilizing wire connections to phase buses, neutral bus and ground bus.
 - 6. Integral disconnect switch capable of passing full rated surge current.
 - 7. Multiple suppression circuits with current sharing.
 - 8. LED indicator lights for power and protection status.
 - 9. Monitoring system capable of the following:

- a. Number of transient surges, overvoltage and undervoltage.
 - b. Neutral-to-ground voltage and current.
 - c. MI filter status.
 - d. Percentage of protection available.
- 10. Audible alarm with silencing switch to indicate when protection has failed.
 - 11. Dual set of dry contacts rated at 5A and 250VAC for remote monitoring of protection status.
 - 12. Field testable with test data from factory provided comparison.
 - 13. Field replaceable surge protection modules.
- B. Peak Single-Impulse Surge Current Rating of 200kA per mode.
- C. Connection Means: Permanent
- D. Protection modes and UL 1449 SVR for voltages of 480/277V, 3-Phase, 4-Wire, grounded wye circuits shall be as follows:
 - 1. Line to Neutral: 800V
 - 2. Line to Ground: 1000V
 - 3. Neutral to Ground: 900V
- E. EMI noise rejection or attenuation values shall comply with those test and evaluation procedures as outlined in NEMA LS-1 1992.

2.03 POWER DISTRIBUTION PANELBOARD/ MCC SPD (TYPE-II)

- A. Surge Protection Device Description: Modular design with field-replaceable module mounted externally to the panelboard or MCC with EMI filtering and the following features:
 - 1. Supplied with fuses rated at 200kA interrupting capacity (AIC).
 - 2. Fabrication using bolted compression lugs for internal wiring.
 - 3. Utilizing copper bus bars and bolted connections to phase buses, neutral bus and ground bus.
 - 4. Utilizing wire connections to phase buses, neutral bus and ground bus.
 - 5. Integral disconnect switch capable of passing full rated surge current or dedicated fuse or breaker.
 - 6. Multiple suppression circuits with current sharing.
 - 7. LED indicator lights for power and protection status.
 - 8. Monitoring system capable of the following:
 - a. Number of transient surges, overvoltages and undervoltages.
 - b. Neutral-to-ground voltage and current.
 - c. Percentage of protection available.

9. Audible alarm with silencing switch to indicate when protection has failed.
 10. Dual set of dry contacts rated at 5A and 250VAC for remote monitoring of protection status.
 11. Field testable with test data from factory provided comparison.
 12. Field replaceable surge protection modules.
- B. Peak Single-Impulse Surge Current Rating of 150kA per mode.
- C. Connection Means: Permanent
- D. Protection modes and UL 1449 SVR for voltages of 480/277V, 3-Phase, 4-Wire, grounded wye circuits shall be as follows:
1. Line to Neutral: 900V
 2. Line to Ground: 900V
 3. Neutral to Ground: 900V
- E. EMI noise rejection or attenuation values shall comply with those test and evaluation procedures as outlined in NEMA LS-1 1992.

2.04 LIGHTING PANELBOARD SPD (TYPE-II)

- A. Surge Protection Device Description: Modular design with field-replaceable module mounted externally to the panelboard with EMI filtering and the following features:
1. Supplied with fuses rated at 200kA interrupting capacity (AIC).
 2. Fabrication using bolted compression lugs for internal wiring.
 3. Utilizing copper bus bars and bolted connections to phase buses, neutral bus and ground bus.
 4. Utilizing wire connections to phase buses, neutral bus and ground bus.
 5. Integral disconnect switch capable of passing full rated surge current or dedicated fuse or breaker.
 6. Multiple suppression circuits with current sharing.
 7. LED indicator lights for power and protection status.
 8. Monitoring system capable of the following:
 - a. Number of transient surges, overvoltages and undervoltages.
 - b. Neutral-to-ground voltage and current.
 - c. Percentage of protection available.
 9. Audible alarm with silencing switch to indicate when protection has failed.
 10. Dual set of dry contacts rated at 5A and 250VAC for remote monitoring of protection status.
 11. Field testable with test data from factory provided comparison.
 12. Field replaceable surge protection modules.

- B. Peak Single-Impulse Surge Current Rating of 60kA per mode.
- C. Connection Means: Permanent
- D. Protection modes and UL 1449 SVR for voltages of 208/120V, 3-Phase, 4-Wire, grounded wye circuits shall be as follows:
 - 1. Line to Neutral: 400V
 - 2. Line to Ground: 500V
 - 3. Neutral to Ground: 500V
- E. Protection modes and UL 1449 SVR for 240/120V, 1-Phase, 3-Wire circuits shall be as follows:
 - 1. Line to Neutral: 400V
 - 2. Line to Ground: 500V
 - 3. Neutral to Ground: 500V
- F. EMI noise rejection or attenuation values shall comply with those test and evaluation procedures as outlined in NEMA LS-1 1992.

PART 3 – EXECUTION

3.01 INSTALLATION OF SURGE PROTECTION DEVICE (SPD)

- A. For Dual Rated Surge Protection (listed as both Surge Arrestor and SPD) for service entrance, product can be placed on either Line or Load side of the Service Entrance Equipment.
 - 1. Provide and install circuit breakers or fuses as shown in the Contract Documents.
- B. For all remaining SPD devices:
 - 1. Provide and install circuit breakers or fuses as shown in the Contract Documents.
- C. Install SPD devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not connect neutral and ground leads together.
- D. SPD devices shall not be integrated with Switchgear or Panelboards as recommended by IEEE-1100, Section 8.4.2.5.

- E. All SPD devices shall have the raceway between the SPD and the switchgear enclosure sealed with approved fire sealant. The sealant shall prevent vapors from entering the switchgear enclosure.

3.02 PLACING EQUIPMENT INTO SERVICE

- A. Do not energize or connect service entrance equipment, panelboards, control panels or telephone/data equipment to their sources until surge protection devices are installed and connected.

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Contractor shall engage a factory-authorized service representative to perform inspections, field tests and adjustments to the equipment including all connections. Service Representative shall report results in writing to the Engineer.
 - 1. Verify that the electrical wiring installation complies with manufacturer's written installation instructions and requirements.
 - 2. After installation of SPD devices but before circuitry has been energized, test for compliance with requirements.
 - 3. Complete installation checks according to manufacturer's written instructions.
 - 4. Remove and replace malfunctioning SPD devices and retest as specified as above.

END OF SECTION

SECTION 31 31 16 TERMITE CONTROL

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Soil treatment with termiticide in accordance with the 2020 Florida Building Code, Building, 7th Edition.

1.02 SUBMITTALS

- A. All submittals shall be in accordance with Specification 01 33 00 – Shop Drawings, Project Data and Samples and inclusive of any additional items as outlined in this specification.
- B. Product Data: For each type of product indicated. Include the EPA-Registered Label.
- C. Product certificates
- D. Soil Treatment Application Report: Include the following:
 - 1. Date and time of application
 - 2. Moisture content of soil before application
 - 3. Brand name and manufacturer of termiticide
 - 4. Quantity of undiluted termiticide used
 - 5. Dilutions, methods, volumes, and rates of application used
 - 6. Areas of application
 - 7. Water source for application

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located.
- B. Regulatory Requirements:
 - 1. 2023 Florida Building Code, Building, 8th Edition
 - a. Section 1816 Termite Protection, paragraphs 1816.1 and 1816.2

b. Section 2114 Termite Protection, paragraph 2114.1 Cleaning

2. Formulate and apply termiticides according to the EPA-Registered Label.

1.04 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Termiticides

- a. Aventis Environmental Science USA LP; Termidor
- b. Bayer Corporation; Premise 75
- c. Dow AgroSciences LLC; Dursban TC
- d. Approved Equal

2. Borates

- a. Nisus Corp.; Bora-Care, Jecta
- b. NovaGuard Technologies, Inc.; Armor-Guard, Shell-Guard
- c. U.S. Borax Inc.; Tim-Bor
- d. Approved Equal

2.02 SOIL TREATMENT

A. Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

PART 3 - EXECUTION

3.01 PREPARATION

A. General: Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

- B. Soil Treatment Preparation: Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

3.02 APPLYING SOIL TREATMENT

- A. **Warning:** Do not treat soil under slabs at well sites nor around any of the well sites.
- B. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
 - 1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 - 2. Foundations: Adjacent soil including soil along the entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating the slab, and around interior column footers, piers, and chimney bases; also along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
 - 3. Masonry: Treat voids
 - 4. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- C. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- D. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- E. Post warning signs in areas of application.
- F. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION

SECTION V

CONTRACT DOCUMENTS

Table of Contents

PUBLIC CONSTRUCTION BOND	1
CONTRACT.....	4
CONSENT OF SURETY TO FINAL PAYMENT	8
PROPOSAL/BID BOND	9
AFFIDAVIT	10
NON-COLLUSION AFFIDAVIT	11
PROPOSAL.....	12
CITY OF CLEARWATER ADDENDUM SHEET	14
BIDDER’S PROPOSAL.....	15
SCRUTINIZED COMPANIES AND BUSINESS OPERATIONS WITH CUBA AND SYRIA CERTIFICATION FORM.....	16
SCRUTINIZED COMPANIES THAT BOYCOTT ISRAEL LIST CERTIFICATION FORM.....	17

Bond No.: _____

PUBLIC CONSTRUCTION BOND

(1)

This bond is given to comply with § 255.05, Florida Statutes, and any action instituted by a claimant under this bond for payment must be in accordance with the notice and time limitation provisions in subsections (2) and (10).

Pursuant to § 255.05(1)(b), Florida Statutes, “**Before commencing the work** or before recommencing the work after a default or abandonment, **the contractor shall provide to the public entity a certified copy of the recorded bond**. Notwithstanding the terms of the contract or any other law governing prompt payment for construction services, the public entity may not make a payment to the contractor until the contractor has complied with this paragraph.”

CONTRACTOR**SURETY****OWNER**_____
[name]_____
[name]

City of Clearwater
Engineering
100 S. Myrtle Avenue
Clearwater, FL 33756
(727) 562-4750

[principal business address]_____
[principal business address]_____
[phone number]_____
[phone number]**PROJECT NAME: NE WRF MCC-1, DC1 & 2 REPLACEMENT****PROJECT NO.: 17-0028-UT****PROJECT DESCRIPTION:** The major Work can be described as follows:

The creation of a separate Electrical Room within the existing Control Building electrical area. Electrical Room to be air conditioned with a raised “data center” floor capable of supporting the electrical equipment. Room to have mezzanine floor with staircase and double doors.

New access door to Blower Room from Control Building electrical area and modifications to existing concrete floor to address subsidence.

The replacement and relocation of the 2nd Anoxic Mixer motor control center (MCC-1) and the switchgear distribution centers (DC-1 and DC-2) to be installed in new electrical room. Removal of existing FRP structure with existing MCC-1

Project includes a new 1200A Nema 4X Service Entrance Breaker with new Utility transformer connection; new Automatic Transfer Switch, NEMA 12 switchboards, “Smart” MCC, Integral Power Center, panelboards, and Trystar generator load bank tap box, all associated concrete ductbanks, handholes, and cable trays. Project also includes incorporation of “Smart” MCC into existing SCADA system which will require programming services.

Existing ATS shall be offered to City for salvage.

As part of structural portion of the project a concrete block wall and footer will be replaced due to failure with a new grade beam foundation and CMU block. Equipment attached to the wall will need to be detached, temporarily supported and re-attached. Replacement of some of the equipment as noted is a part of this effort.

Blower Room plenum area to be filled in and intake structure removed. Refer to drawings.

Contractor responsible for maintenance of plant operations, provide any or all temporary power or controls connections, which may include temporary primary generation and standby power equipment.

BY THIS BOND, We, _____, as Contractor, and _____, a corporation, as Surety, are bound to the City of Clearwater, Florida, herein called Owner, in the sum of \$[x,xxx,xxx.xx], for payment of which we bind ourselves, our heirs, personal representatives, successors, and assigns, jointly and severally.

THE CONDITION OF THIS BOND is that if Contractor:

1. Performs the contract dated _____, between Contractor and Owner for construction of NE WRF MCC-1, DC1 & 2 REPLACEMENT the contract documents being made a part of this bond by reference (which include the Advertisement for Bids, Proposal, Contract, Surety Bond, Instructions to Bidders, General Conditions, Plans, Technical Specifications and Appendix, and such alterations as may be made in said Plans and Specifications as therein provided for), at the times and in the manner prescribed in the contract; and
2. Promptly makes payments to all claimants, as defined in Section 255.05(1), Florida Statutes, supplying Contractor with labor, materials, or supplies, used directly or indirectly by Contractor in the prosecution of the work provided for in the contract; and

Bond No.: _____

PUBLIC CONSTRUCTION BOND

(2)

- 3. Pays Owner all losses, damages, expenses, costs, and attorney’s fees, including appellate proceedings, that Owner sustains because of a default by Contractor under the contract; and
- 4. To the limits of § 725.06(2), Florida Statutes, shall indemnify and hold harmless Owner, their officers and employees, from liabilities, damages, losses and costs, including, but not limited to, reasonable attorney’s fees, to the extent caused by the negligence, recklessness, or intentional wrongful misconduct of Contractor and persons employed or utilized by Contractor in the performance of the construction contract; and
- 5. Performs the guarantee of all work and materials furnished under the contract for the time specified in the contract, then this bond is void; otherwise it remains in full force.
- 6. Any action instituted by a claimant under this bond for payment must be in accordance with the notice and time limitation provisions in Section 255.05(2), Florida Statutes.
- 7. Any changes in or under the contract documents and compliance or noncompliance with any formalities connected with the contract or the changes does not affect Surety’s obligation under this bond, and Surety does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the work or to the specifications.

IN TESTIMONY WHEREOF, witness the hands and seals of the parties hereto this _____ day of _____, 20__.

*(If sole Ownership or Partnership, two (2) Witnesses required).
(If Corporation, Secretary only will attest and affix seal).*

[TYPE LEGAL NAME OF CONTRACTOR]

By: _____
Title: _____
Print Name: _____

WITNESS:

WITNESS:

Corporate Secretary or Witness
Print Name: _____

Print Name: _____

(affix corporate seal)

(Corporate Surety)

By: _____
ATTORNEY-IN-FACT
Print Name: _____

(affix corporate seal)

(Power of Attorney must be attached)

CONTRACT

(1)

This **CONTRACT** made and entered into this ___ day of _____, 20__ by and between the City of Clearwater, Florida, a municipal corporation, hereinafter designated as the "City", and _____, of the City of _____ County of _____ and State of Florida, hereinafter designated as the "Contractor".

[Or, if out of state:]

This **CONTRACT** made and entered into this ___ day of _____, 20__ by and between the City of Clearwater, Florida, a municipal corporation, hereinafter designated as the "City", and _____, a/an _____ (State) Corporation authorized to do business in the State of Florida, of the City of _____ County of _____ and State of _____, hereinafter designated as the "Contractor".

WITNESSETH:

That the parties to this contract each in consideration of the undertakings, promises and agreements on the part of the other herein contained, do hereby undertake, promise and agree as follows:

The Contractor, and his or its successors, assigns, executors or administrators, in consideration of the sums of money as herein after set forth to be paid by the City and to the Contractor, shall and will at **their** own cost and expense perform all labor, furnish all materials, tools and equipment for the following:

PROJECT NAME: NE WRF MCC-1, DC1 & 2 REPLACEMENT

PROJECT NO.: 17-0028-UT

in the amount of \$ _____

In accordance with such proposal and technical supplemental specifications and such other special provisions and drawings, if any, which will be submitted by the City, together with any advertisement, instructions to bidders, general conditions, technical specifications, proposal and bond, which may be hereto attached, and any drawings if any, which may be herein referred to, are hereby made a part of this contract, and all of said work to be performed and completed by the contractor and its successors and assigns shall be fully completed in a good and workmanlike manner to the satisfaction of the City.

If the Contractor should fail to comply with any of the terms, conditions, provisions or stipulations as contained herein within the time specified for completion of the work to be performed by the Contractor, then the City, may at its option, avail itself of any or all remedies provided on its behalf and shall have the right to proceed to complete such work as Contractor is obligated to perform in accordance with the provisions as contained herein.

CONTRACT

(2)

THE CONTRACTOR AND HIS OR ITS SUCCESSORS AND ASSIGNS DOES HEREBY AGREE TO ASSUME THE DEFENSE OF ANY LEGAL ACTION WHICH MAY BE BROUGHT AGAINST THE CITY AS A RESULT OF THE CONTRACTOR'S ACTIVITIES ARISING OUT OF THIS CONTRACT AND FURTHERMORE, IN CONSIDERATION OF THE TERMS, STIPULATIONS AND CONDITIONS AS CONTAINED HEREIN, AGREES TO HOLD THE CITY FREE AND HARMLESS FROM ANY AND ALL CLAIMS FOR DAMAGES, COSTS OF SUITS, JUDGMENTS OR DECREES RESULTING FROM ANY CLAIMS MADE UNDER THIS CONTRACT AGAINST THE CITY OR THE CONTRACTOR OR THE CONTRACTOR'S SUB CONTRACTORS, AGENTS, SERVANTS OR EMPLOYEES RESULTING FROM ACTIVITIES BY THE AFOREMENTIONED CONTRACTOR, SUB CONTRACTOR, AGENT SERVANTS OR EMPLOYEES, TO THE LIMITS OF § 725.06(2).

In addition to the foregoing provisions, the Contractor agrees to conform to the following requirements:

In connection with the performance of work under this contract, the Contractor agrees not to discriminate against any employee or applicant for employment because of race, sex, religion, color, or national origin. The aforesaid provision shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; lay off or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post hereafter in conspicuous places, available for employees or applicants for employment, notices to be provided by the contracting officer setting forth the provisions of the non-discrimination clause.

The Contractor further agrees to insert the foregoing provisions in all contracts hereunder, including contracts or agreements with labor unions and/or worker's representatives, except sub-contractors for standard commercial supplies or raw materials.

It is mutually agreed between the parties hereto that time is of the essence of this contract, and in the event that the work to be performed by the Contractor is not completed within the time stipulated herein, it is then further agreed that the City may deduct from such sums or compensation as may be due to the Contractor the sum of **\$1,000.00 per day** for each day that the work to be performed by the Contractor remains incomplete beyond the time limit specified herein, which sum of **\$1,000.00 per day** shall only and solely represent damages which the City has sustained by reason of the failure of the Contractor to complete the work within the time stipulated, it being further agreed that this sum is not to be construed as a penalty but is only to be construed as liquidated damages for failure of the Contractor to complete and perform all work within the time period as specified in this contract.

It is further mutually agreed between the City and the Contractor that if, any time after the execution of this contract and the public construction bond which is attached hereto for the faithful performance of the terms and conditions as contained herein by the Contractor, that the City shall at any time deem the surety or sureties upon such public construction bond to be unsatisfactory or if, for any reason, the said bond ceases to be adequate in amount to cover the performance of the work the Contractor shall, at his or its own expense, within ten (10) days after receipt of written notice from the City to do so, furnish an additional bond or bonds in such term and amounts and with such surety or sureties as shall be satisfactory to the City. If such an event occurs, no further payment shall be made to the Contractor under the terms and provisions of this contract until such new or additional security bond guaranteeing the faithful performance of the work under the terms hereof shall be completed and furnished to the City in a form satisfactory to it.

CONTRACT

(3)

In addition to all other contract requirements as provided by law, the contractor executing this agreement agrees to comply with public records law.

IF THE CONTRACTOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, THE CONTRACTORS DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS CONTRACT. CONTACT THE CUSTODIAN OF PUBLIC RECORDS AT 727-562-4092, Rosemarie.Call@myclearwater.com, 600 Cleveland St. Clearwater, FL 33756

The contractor's agreement to comply with public records law applies specifically to:

- a) Keep and maintain public records required by the City of Clearwater (hereinafter “public agency”) to perform the service being provided by the contractor hereunder.
- b) Upon request from the public agency’s custodian of public records, provide the public agency with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a cost that does not exceed the cost provided for in Chapter 119, Florida Statutes, as may be amended from time to time, or as otherwise provided by law.
- c) Ensure that the public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law for the duration of the contract term and following completion of the contract if the contractor does not transfer the records to the public agency.
- d) Upon completion of the contract, transfer, at no cost, to the public agency all public records in possession of the contractor or keep and maintain public records required by the public agency to perform the service. If the contractor transfers all public records to the public agency upon completion of the contract, the contractor shall destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. If the contractor keeps and maintains public records upon completion of the contract, the contractor shall meet all applicable requirements for retaining public records. All records stored electronically must be provided to the public agency, upon request from the public agency’s custodian of public records, in a format that is compatible with the information technology systems of the public agency.
- e) A request to inspect or copy public records relating to a public agency’s contract for services must be made directly to the public agency. If the public agency does not possess the requested records, the public agency shall immediately notify the contractor of the request and the contractor must provide the records to the public agency or allow the records to be inspected or copied within a reasonable time.
- f) The contractor hereby acknowledges and agrees that if the contractor does not comply with the public agency’s request for records, the public agency shall enforce the contract provisions in accordance with the contract.
- g) A contractor who fails to provide the public records to the public agency within a reasonable time may be subject to penalties under Section 119.10, Florida Statutes.
- h) If a civil action is filed against a contractor to compel production of public records relating to a public agency’s contract for services, the court shall assess and award against the contractor the reasonable costs of enforcement, including reasonable attorney fees, if:
 1. The court determines that the contractor unlawfully refused to comply with the public records request within a reasonable time; and

CONTRACT

(4)

- 2. **At least 8 business days before filing the action, the plaintiff provided written notice of the public records request, including a statement that the contractor has not complied with the request, to the public agency and to the contractor.**
- i) **A notice complies with subparagraph (h)2. if it is sent to the public agency’s custodian of public records and to the contractor at the contractor’s address listed on its contract with the public agency or to the contractor’s registered agent. Such notices must be sent by common carrier delivery service or by registered, Global Express Guaranteed, or certified mail, with postage or shipping paid by the sender and with evidence of delivery, which may be in an electronic format.**
- j) **A contractor who complies with a public records request within 8 business days after the notice is sent is not liable for the reasonable costs of enforcement.**

IN WITNESS WHEREOF, the parties to the agreement have hereunto set their hands and seals and have executed this Agreement, the day and year first above written.

**CITY OF CLEARWATER
IN PINELLAS COUNTY, FLORIDA**

By: _____
Jon P. Jennings
City Manager

(SEAL)

Attest:

Countersigned:

Rosemarie Call
City Clerk

By: _____
Frank Hibbard
Mayor

Approved as to form:

Owen Kohler
Assistant City Attorney

Contractor must indicate whether:

_____ Corporation, _____ Partnership, _____ Company, or _____ Individual

(Contractor)

By: _____ (SEAL)
Print Name: _____
Title: _____

The person signing shall, in his own handwriting, sign the Principal's name, his own name, and his title; where the person is signing for a Corporation, he must, by Affidavit, show his authority to bind the Corporation – **provide Affidavit.**

CONSENT OF SURETY TO FINAL PAYMENT

TO OWNER: City of Clearwater PROJECT NAME: NE WRF MCC-1, DC1 & 2 REPLACEMENT

[Dept. owning project] PROJECT NO.: 17-0028-UT

100 S. Myrtle Ave. CONTRACT DATE: []

Clearwater, FL 33756 BOND NO.: [], recorded in O.R. Book [], Page [], of the Public Records of Pinellas County, Florida.

CONTRACTOR: []

Pursuant to § 255.05(11), Florida Statutes, and in accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the:

[insert name of Surety]
[address]
[address]

,SURETY,

on bond of

[insert name of Contractor]
[address]
[address]

,CONTRACTOR,

hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve Surety of any of its obligations to

City of Clearwater
[Dept. owning project]
100 S. Myrtle Ave.
Clearwater, FL 33756

,OWNER,

as set forth in said Surety’s bond.

IN WITNESS WHEREOF, the Surety has hereunto set its hand this ___ day of _____, _____

(Surety)

(Signature of authorized representative)

(Printed name and title)

Attest:
(Seal):

PROPOSAL/BID BOND

(Not to be filled out if a certified check is submitted)

KNOWN ALL MEN BY THESE PRESENTS: That we, the undersigned, _____
_____ as Contractor, and _____
_____ as Surety, whose address is _____,
_____ are held and firmly bound unto the City
of Clearwater, Florida, in the sum of _____ Dollars
(\$ _____) (being a minimum of 10% of Contractor's total bid amount) for the payment of which,
well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors,
administrators, successors and assigns.

The condition of the above obligation is such that if the attached Proposal of _____
_____ as Contractor, and _____ as Surety, for
work specified as: _____

_____ all as stipulated in said Proposal, by doing all work incidental thereto, in accordance with the plans and
specifications provided herefor, all within Pinellas County, is accepted and the contract awarded to the
above named bidder, and the said bidder shall within ten days after notice of said award enter into a contract,
in writing, and furnish the required Public Construction Bond with surety or sureties to be approved by the
City Manager, this obligation shall be void, otherwise the same shall be in full force and virtue by law and
the full amount of this Proposal/Bid Bond will be paid to the City as stipulated or liquidated damages.

Principal must indicate whether:
_____ Corporation, _____ Partnership, _____ Company, or _____ Individual

Signed this _____ day of _____, 20____.

Contractor

Principal

By: _____
Title

Surety

The person signing shall, in his own handwriting, sign the Principal's name, his own name, and his title;
where the person is signing for a Corporation, he must, by Affidavit, show his authority to bind the
Corporation – **provide Affidavit.**

AFFIDAVIT

(To be filled in and executed if the bidder is a corporation)

STATE OF FLORIDA)

COUNTY OF _____)

_____, being duly sworn, deposes and says that he/she is Secretary of _____ a corporation organized and existing under and by virtue of the laws of the State of Florida, and having its principal office at:

(Street & Number) (City) (County) (State)

Affiant further says that he is familiar with the records, minute books and by-laws of

(Name of Corporation)

Affiant further says that _____ is _____
(Officer's Name) (Title)

of the corporation, is duly authorized to sign the Proposal for _____

or said corporation by virtue of _____
(state whether a provision of by laws or a Resolution of Board of Directors. If by Resolution give date of adoption).

Affiant

Sworn to before me this _____ day of _____, 20____.

Notary Public

Type/print/stamp name of Notary

Title or rank, and Serial No., if any

NON-COLLUSION AFFIDAVIT

STATE OF FLORIDA)

COUNTY OF _____)

_____ being, first duly sworn, deposes and says that he is

_____ of _____,
the party making the foregoing Proposal or Bid; that such Bid is genuine and not collusive or sham: that said bidder is not financially interested in or otherwise affiliated in a business way with any other bidder on the same contract; that said bidder has not colluded, conspired, connived, or agreed, directly or indirectly, with any bidders or person, to put in a sham bid or that such other person shall refrain from bidding, and has not in any manner, directly or indirectly, sought by agreement or collusion, or communication or conference, with any person, to fix the bid price or affiant or any other bidder, or to fix any overhead, profit or cost element of said bid price, or that of any other bidder, or to secure any advantage against the City of Clearwater, Florida, or any person or persons interested in the proposed contract; and that all statements contained in said proposal or bid are true; and further, that such bidder has not directly or indirectly submitted this bid, or the contents thereof, or divulged information or data relative thereto to any association or to any member or agent thereof.

Affiant

Sworn to and subscribed before me this _____ day of _____, 20_____.

Notary Public

PROPOSAL

(1)

TO THE CITY OF CLEARWATER, FLORIDA, for

NE WRF MCC-1, DC1 & 2 REPLACEMENT-17-0028-UT

and doing such other work incidental thereto, all in accordance with the contract documents, marked

NE WRF MCC-1, DC1 & 2 REPLACEMENT-17-0028-UT

Every bidder must take notice of the fact that even though his proposal be accepted and the documents signed by the bidder to whom an award is made and by those officials authorized to do so on behalf of the City of Clearwater, Florida, that no such award or signing shall be considered a binding contract without a certificate from the Finance Director that funds are available to cover the cost of the work to be done, or without the approval of the City Attorney as to the form and legality of the contract and all the pertinent documents relating thereto having been approved by said City Attorney; and such bidder is hereby charged with this notice.

The signer of the Proposal, as bidder, also declares that the only person, persons, company or parties interested in this Proposal, are named in this Proposal, that he has carefully examined the Advertisement, Instructions to Bidders, Contract Specifications, Plans, Supplemental Specifications, General Conditions, Special Provisions, and Public Construction Bond, that he or his representative has made such investigation as is necessary to determine the character and extent of the work and he proposes and agrees that if the Proposal be accepted, he will contract with the City of Clearwater, Florida, in the form of contract; hereto annexed, to provide the necessary labor, materials, machinery, equipment, tools or apparatus, do all the work required to complete the contract within the time mentioned in the General Conditions and according to the requirements of the City of Clearwater, Florida, as herein and hereinafter set forth, and furnish the required surety bonds for the following prices to wit:

If the foregoing Proposal shall be accepted by the City of Clearwater, Florida, and the undersigned shall fail to execute a satisfactory contract as stated in the Advertisement herein attached, then the City may, at its option determine that the undersigned has abandoned the contract, and thereupon this Proposal shall be null and void, and the certified check or bond accompanying this Proposal, shall be forfeited to become the property of the City of Clearwater, Florida, and the full amount of said check shall be retained by the City, or if the Proposal Bond be given, the full amount of such bond shall be paid to the City as stipulated or liquidated damages; otherwise, the bond or certified check accompanying this Proposal, or the amount of said check, shall be returned to the undersigned as specified herein.

PROPOSAL

(2)

Attached hereto is a bond or certified check on _____
_____ Bank, for the sum of _____
_____ (\$ _____)
(being a minimum of 10% of Contractor's total bid amount).

The full names and residences of all persons and parties interested in the foregoing bid are as follows:

(If corporation, give the names and addresses of the President and Secretary. If firm or partnership, the names and addresses of the members or partners. The Bidder shall list not only his name but also the name of any person with whom bidder has any type of agreement whereby such person's improvements, enrichment, employment or possible benefit, whether sub-contractor, materialman, agent, supplier, or employer is contingent upon the award of the contract to the bidder).

NAMES:

ADDRESSES:

_____	_____
_____	_____
_____	_____
_____	_____

Signature of Bidder: _____

The person signing shall, in his own handwriting, sign the Principal's name, his own name and his title. Where the person signing for a corporation is other than the President or Vice President, he must, by affidavit, show his authority, to bind the corporation.

Principal: _____

By: _____ Title: _____

Company Legal Name: _____

Doing Business As (if different than above): _____

Business Address of Bidder: _____

City and State: _____ Zip Code _____

Phone: _____ Email Address: _____

Dated at _____, this _____ day of _____, A.D., 20__.

CITY OF CLEARWATER
ADDENDUM SHEET

PROJECT: NE WRF MCC-1, DC1 & 2 REPLACEMENT – 17-0028-UT

Acknowledgment is hereby made of the following addenda received since issuance of Plans and Specifications.

Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____

(Name of Bidder)

(Signature of Officer)

(Title of Officer)

(Date)

**SCRUTINIZED COMPANIES AND BUSINESS OPERATIONS WITH
CUBA AND SYRIA CERTIFICATION FORM**

PER SECTION III, ITEM 25, IF YOUR BID IS \$1,000,000 OR MORE, THIS FORM MUST BE COMPLETED AND SUBMITTED WITH THE BID PROPOSAL. FAILURE TO SUBMIT THIS FORM AS REQUIRED, MAY DEEM YOUR SUBMITTAL NONRESPONSIVE.

The affiant, by virtue of the signature below, certifies that:

1. The vendor, company, individual, principal, subsidiary, affiliate, or owner is aware of the requirements of section 287.135, Florida Statutes, regarding companies on the Scrutinized Companies with Activities in Sudan List, the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List, or engaging in business operations in Cuba and Syria; and
2. The vendor, company, individual, principal, subsidiary, affiliate, or owner is eligible to participate in this solicitation and is not listed on either the Scrutinized Companies with Activities in Sudan List, the Scrutinized Companies with Activities in the Iran Petroleum Sector List, or engaged in business operations in Cuba and Syria; and
3. Business Operations means, for purposes specifically related to Cuba or Syria, engaging in commerce in any form in Cuba or Syria, including, but not limited to, acquiring, developing, maintaining, owning, selling, possessing, leasing or operating equipment, facilities, personnel, products, services, personal property, real property, military equipment, or any other apparatus of business or commerce; and
4. If awarded the Contract (or Agreement), the vendor, company, individual, principal, subsidiary, affiliate, or owner will immediately notify the City of Clearwater in writing, no later than five (5) calendar days after any of its principals are placed on the Scrutinized Companies with Activities in Sudan List, the Scrutinized Companies with Activities in the Iran Petroleum Sector List, or engages in business operations in Cuba and Syria.

Authorized Signature

Printed Name

Title

Name of Entity/Corporation

STATE OF _____

COUNTY OF _____

The foregoing instrument was acknowledged before me on this _____ day of _____, 20____, by _____ (name of person whose signature is being notarized) as the _____ (title) of _____ (name of corporation/entity), personally known to me as described herein _____, or produced a _____ (type of identification) as identification, and who did/did not take an oath.

Notary Public

Printed Name

My Commission Expires: _____

NOTARY SEAL ABOVE

SCRUTINIZED COMPANIES THAT BOYCOTT ISRAEL LIST
CERTIFICATION FORM

PER SECTION III, ITEM 25, THIS FORM MUST BE COMPLETED AND SUBMITTED WITH THE BID PROPOSAL. FAILURE TO SUBMIT THIS FORM AS REQUIRED, MAY DEEM YOUR SUBMITTAL NONRESPONSIVE.

The affiant, by virtue of the signature below, certifies that:

1. The vendor, company, individual, principal, subsidiary, affiliate, or owner is aware of the requirements of section 287.135, Florida Statutes, regarding companies on the Scrutinized Companies that Boycott Israel List, or engaged in a boycott of Israel; and
2. The vendor, company, individual, principal, subsidiary, affiliate, or owner is eligible to participate in this solicitation and is not listed on the Scrutinized Companies that Boycott Israel List, or engaged in a boycott of Israel; and
3. “Boycott Israel” or “boycott of Israel” means refusing to deal, terminating business activities, or taking other actions to limit commercial relations with Israel, or persons or entities doing business in Israel or in Israeli-controlled territories, in a discriminatory manner. A statement by a company that it is participating in a boycott of Israel, or that it has initiated a boycott in response to a request for a boycott of Israel or in compliance with, or in furtherance of, calls for a boycott of Israel, may be considered as evidence that a company is participating in a boycott of Israel; and
4. If awarded the Contract (or Agreement), the vendor, company, individual, principal, subsidiary, affiliate, or owner will immediately notify the City of Clearwater in writing, no later than five (5) calendar days after any of its principals are placed on the Scrutinized Companies that Boycott Israel List, or engaged in a boycott of Israel.

Authorized Signature

Printed Name

Title

Name of Entity/Corporation

STATE OF _____

COUNTY OF _____

The foregoing instrument was acknowledged before me on this _____ day of _____, 20____, by _____ (name of person whose signature is being notarized) as the _____ (title) of _____ (name of corporation/entity), personally known to me as described herein _____, or produced a _____ (type of identification) as identification, and who did/did not take an oath.

Notary Public

Printed Name

My Commission Expires: _____
NOTARY SEAL ABOVE

APPENDIX

FORMS AND OTHER PROJECT DOCUMENTATION

Table of Contents

VERIFICATION OF EMPLOYMENT ELIGIBILITY FORM.....	1
GEOTECHNICAL SOIL REPORT	2
ASBESTOS REPORT	3

VERIFICATION OF EMPLOYMENT ELIGIBILITY FORM

PER FLORIDA STATUTE 448.095, CONTRACTORS AND SUBCONTRACTORS MUST REGISTER WITH AND USE THE E-VERIFY SYSTEM TO VERIFY THE WORK AUTHORIZATION STATUS OF ALL NEWLY HIRED EMPLOYEES.

THIS FORM MUST BE COMPLETED AND SUBMITTED WITH THE BID/PROPOSAL. FAILURE TO SUBMIT THIS FORM AS REQUIRED MAY DEEM YOUR SUBMITTAL NONRESPONSIVE.

The affiant, by virtue of the signature below, certifies that:

1. The Contractor and its Subcontractors are aware of the requirements of Florida Statute 448.095.
2. The Contractor and its Subcontractors are registered with and using the E-Verify system to verify the work authorization status of newly hired employees.
3. The Contractor will not enter into a contract with any Subcontractor unless each party to the contract registers with and uses the E-Verify system.
4. The Subcontractor will provide the Contractor with an affidavit stating that the Subcontractor does not employ, contract with, or subcontract with unauthorized alien.
5. The Contractor must maintain a copy of such affidavit.
6. The City may terminate this Contract on the good faith belief that the Contractor or its Subcontractors knowingly violated Florida Statutes 448.09(1) or 448.095(2)(c).
7. If this Contract is terminated pursuant to Florida Statute 448.095(2)(c), the Contractor may not be awarded a public contract for at least 1 year after the date on which this Contract was terminated.
8. The Contractor is liable for any additional cost incurred by the City as a result of the termination of this Contract.

Authorized Signature

Printed Name

Title

Name of Entity/Corporation

STATE OF _____

COUNTY OF _____

The foregoing instrument was acknowledged before me by means of physical presence or online notarization on, this ____ day of _____, 20____, by _____ (name of person whose signature is being notarized) as the _____ (title) of _____ (name of corporation/entity), personally known _____, or produced _____ (type of identification) as identification, and who did/did not take an oath.

Notary Public

Printed Name

My Commission Expires: _____

NOTARY SEAL ABOVE

GEO TECHNICAL SOIL REPORT

**REPORT OF THE
SUBSURFACE SOIL INVESTIGATION**

**CONTROL BUILDING
NORTHEAST WWTP
CLEARWATER, FLORIDA**

December 10, 2021

McKim & Creed, Inc.
1365 Hamlet Avenue
Clearwater, Florida 33756

Attention: Mr. Aubrey Haudricourt,
Senior Project Engineer

**RE: Report of the Subsurface Soil Investigation
Control Building
Northeast WWTP
Clearwater, Florida
Our File: 218838**

Dear Aubrey:

In accordance with your authorization, **DRIGGERS ENGINEERING SERVICES, INC.** has conducted a limited investigation of the area of apparent slab settlement and wall cracking within the subject building. Presented herein are the results of our investigation together with recommendations for your consideration.

INVESTIGATION PROGRAM

GROUND PENETRATING RADAR SURVEY – A Ground Penetrating Radar (GPR) survey was performed by our subconsultant, GeoView, Inc. in an effort to detect voids that may be present below the bottom of the existing floor slab as well as to check for deeper anomalous conditions that could be associated with the slab settlement. The results of the GPR survey are included in the report attachments. The reader is invited to review this report for a detailed discussion of the methods of testing and findings.

STANDARD PENETRATION TEST BORING - The GPR survey identified a single deeper anomalous condition that warranted investigation. Although the GPR signal did not detect any

disruption of the soils which might suggest soil raveling, a Standard Penetration Test (SPT) boring was conducted at the center of the anomaly. The boring was advanced to a depth of 30 feet below present grade. The location of the boring is depicted on Plate I of the attachments. A log of the boring is also provided in the attachments. You will note that the upper 6 feet at the boring location was conducted utilizing hand auger equipment to refine the shallow stratigraphy as well as to check for below slab utilities that might be present. A hand cone sounding was conducted within the upper hand augered portion to provide penetration resistance data.

HAND AUGER CLASSIFICATION BORINGS – Plate I of the report illustrations identifies the respective positioning of five (5) classification borings that were performed to examine subgrade soil conditions as well as slab thickness and the presence of voids. The classification borings indicated the presence of predominantly fine sands throughout the depth of investigation. Penetration resistance values varied from very loose to medium dense in consistency. The classification borings indicate that the concrete floor slab varied in thickness to about 4 inches to 7 inches and was underlain by plastic vapor barrier. Hand cone soundings were also performed at each hand auger location. Logs of the borings are presented in the attachments.

LABORATORY TESTING - A limited laboratory classification testing program was implemented to aid in the assessment of the engineering properties of representative soils. The testing consisted of four (4) organic content tests, three (3) grainsize analyses and one (1) Atterberg Limits determination. The results of the testing are provided in the attachments. Also included are the graphical representation of the individual grainsize analyses.

INDICATED SUBSURFACE CONDITIONS

SOIL CONDITIONS - The borings were conducted through an existing slab on grade. The slab thickness ranged from about 4 to 7 inches thick with a typical thickness of about 6 inches. Below the slab, several of the borings identified a gap between the bottom of slab and soils below. The gap ranged from about ¼ inch to 1-1/2 inches. However, the ¼ inch gap could be related to the coring operation itself which uses water to advance the core barrel and may have washed out the soils slightly. The soils beneath the slab consisted of brown and gray fine sands with pockets or seams of clayey fine sand within the upper 4 to 6 feet below grade. These materials likely represent fill soils used to establish site grades or possibly backfill soils associate with below grade construction. Below these depths, dark gray sands with trace organic fines and variable root

concentrations were noted at several borings. The heaviest and thickest concentration of roots occurred at boring HA-1. This zone may represent the previous ground surface elevation prior to site filling. Below the sands with roots, brown and light brown sands with trace silt fines were encountered. The soils throughout these upper zones were generally represented by the SP to SP-SM Unified Soil Classification System (USCS) designation with occasional silty sands (SM) and clayey sands (SC) noted. The sandy soils terminated at the surface of a limestone layer beginning about 12 feet below grade at B-1. Below about 15 feet, a gray and green variably cemented clay unit was sampled to the completion depth of the boring.

Penetration resistance data suggests the soils within the upper 6 feet possess a loose to medium dense relative density. The sandy soils below that were typically very loose in relative density. The deeper clay unit was considered hard in consistency.

GROUNDWATER CONDITIONS - Groundwater levels were recorded at depths of 6 to 7.5 feet below the top of slab. It is important to note that the investigation took place during a period of low rainfall during the typical dry season.

Our review of the soils maps published by the USDA Natural Resources Conservation Service (NRCS) suggests the soils at this site are represented by the Myakka and Urban Land soil series. These soils are characterized by seasonal high groundwater levels between 6 and 18 inches below grade. However, the urban land description recognizes the site may have been regraded or filled historically. Based upon the results of our studies and current groundwater conditions, we would conservatively estimate a normal seasonal high groundwater level at about 2 to 3 feet below the top of slab elevation.

Confirmation of potential fluctuations in groundwater levels would necessitate installing shallow piezometers followed by monitoring groundwater levels throughout the remainder of the wet season.

EVALUATION

OBSERVATIONS - There were several conditions at the existing facility that warranted inspection and investigation. The following presents a summary of our observations.

1. A masonry wall separating the current maintenance shop from the electrical equipment room shows evidence of significant horizontal and stair stepped cracking (Photo #1 in the attachments). Borings HA-3 and HA-3A were performed in this area. According to the structural plans, it is our understanding there is no foundation or thickened slab beneath the wall. This wall is not load bearing.
2. Slab settlement was observed adjacent to the blower bay at the northwest corner of the structure (Photo #2) in the area of borings B-1 and HA-1. Other areas of slab settlement were noted within the electrical equipment room where heavy equipment was once reportedly located on the slab. Boring HA-4 was conducted in that area.
3. Visual inspection by others of the air plenum beneath the blower bay identified water pooled in the plenum. The depth or elevation of the water level within the plenum was not documented. Following pumping the water out, sand was observed in the bottom of the plenum on top of the base slab.

ANTICIPATED AREAS OF REMEDIATION - As previously discussed, the wall separating the maintenance shop from the electrical equipment room has cracked due to settlement of the wall. Based on the soil conditions identified, the settlement of this wall is likely due to the lack of a foundation beneath the wall. Accordingly, instead of attempting to remediate this existing non load bearing wall, the wall will be removed and reconstructed on a foundation. We would expect a wall service load on the order of 1 to 2 kips per lineal foot. It is our understanding that within the areas of slab settlement and/or where voids are detected beneath the slab, the slab will be removed and replaced. Finally, remediation of the plenum structure is expected. The top of the plenum mat slab is about 10'-6" below the finished floor according to record documents and the thickness of the mat slab is 2'-0".

NEW FOUNDATION RECOMMENDATIONS - Our geotechnical studies have identified apparent fill materials historically placed to establish current site grades. Evidence of sands containing larger roots were identified in some of the borings. However, there was no evidence of buried roots at the HA-3 or HA-3A location. The soils below about 6 feet below grade are also very loose in relative density. However, based on the relatively light loads, we would not anticipate significant settlement. Based on the above, the new wall foundation may be designed based upon an allowable net soil bearing pressure of up to 1,500 pounds per square foot. Provided proper subgrade preparation is enacted, wall foundation settlement of about 0.5 inches is expected. Due to the sandy nature of the subgrade soils, the majority of this settlement should occur quickly during construction following the imposition of load.

Included in the report attachments are specific recommendations relative to subgrade preparation and foundation design.

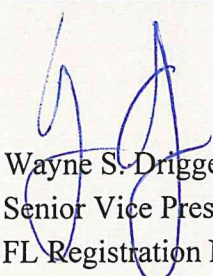
SLAB-ON-GRADE REPLACEMENT - There are several areas of slab subsidence. The GPR survey identified a deep anomaly that was investigated with SPT boring B-1. The SPT boring did not identify conditions consistent with sinkhole activity indicating the GPR anomaly was likely related to a slight change in the soil stratification in that area. The high frequency GPR survey to check for the presence of voids beneath the slab was unable to detect voids beneath the slab. However, cores conducted in the vicinity of slab settlement and adjacent to the air plenum identified gaps between the bottom of slab and the soils on the order ¼ inch to 1-1/2 inches in some areas. You will note that the air plenum had both water and soils present in the bottom of the structure. As discussed previously, the top of the plenum structure is about 10.5 feet below the slab on grade. Groundwater was recorded about 6 to 7.5 feet below the top of slab grade. However, the current investigation took place during the typical dry season. Based on our assessment, groundwater could rise to within a few feet below the slab on grade during the typical wet season. The presence of water and soil in the plenum suggests there is likely a breach or multiple breaches in the plenum structure allowing both soils and groundwater to migrate into the air-filled plenum. This loss of soil has likely caused the observed gaps and slab settlement noted. The deeper root zones, depending on the lateral extent of the zone, may have also contributed to the observed settlement particularly at HA-1 due to slow, long-term decomposition of the organic materials. However, any contribution associated with decomposition will diminish with time such that future settlement would be expected to be minor. Other areas where slab settlement has occurred may have been due to heavy equipment placed on a slab-on-grade that may not have been designed to carry that load.

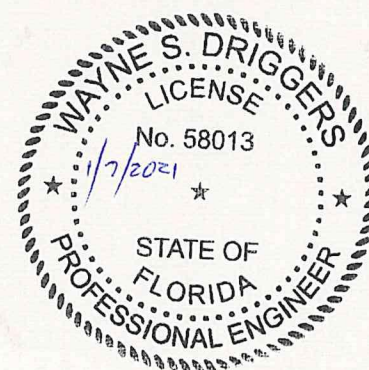
Following removal of existing slabs to be replaced, the subgrade soils should be compacted utilizing hand-guided vibratory sled or impact compactor. The subgrade and any additional fill soils required shall be densified to not less than 95% of the Modified Proctor maximum dry density per ASTM D-1557. The fill soils should consist of fine sands comprising the SP to SP-SM Unified Soil Classification System designation. Utility trenches and ruts should be re-leveled and uniformly compacted to avoid sharp discontinuities in bearing characteristics and slab thickness that could induce cracking.

AIR PLENUM ALTERNATIVES - Based on the above, two (2) options are being contemplated. The first option is to attempt to repair and reseal the plenum structure which could be difficult to thoroughly vet all the potential soil and water access points. The second option would be to effectively abandon the plenum structure which is no longer in use. The upper structural slab above the plenum could be removed followed by placement and compaction of backfill soil materials. The backfill soils should be placed in lifts not to exceed 9 inches and compacted to not less than 95% of the Modified Proctor maximum dry density per ASTM D-1557. The back fill soils should consist of fine sands comprising the SP to SP-SM Unified Soil Classification System designation. A conventional slab-on-grade could then be constructed on the compacted backfill soils.

DRIGGERS ENGINEERING SERVICES, INC. appreciates the opportunity to assist you on this project. Should you have any questions concerning the results of our geotechnical studies, please do not hesitate to contact this office at your convenience.

Respectfully submitted,
DRIGGERS ENGINEERING SERVICES INC.


Wayne S. Driggers, P.E.
Senior Vice President
FL Registration No. 58013



WSD-REP\218806

Copies submitted: (1) email

APPENDIX

**RECOMMENDATIONS FOR FOUNDATION AND
SLAB-ON-GRADE SUBGRADE PREPARATION**

PLATE I – CORE & BORING LOCATION PLAN

STANDARD PENETRATION TEST (SPT) BORING LOGS

HAND AUGER BORING / HAND CONE SOUNDING LOGS

**REPORT OF THE GEOPHYSICAL INVESTIGATION
PREPARED BY GEO VIEW, INC.**

PHOTGRAPHS

RESULTS OF LABORATORY TESTING

GRAINSIZE ANALYSES

METHOD OF TESTING

**RECOMMENDATIONS FOR FOUNDATION AND
SLAB-ON-GRADE SUBGRADE PREPARATION**

RECOMMENDATIONS FOR FOUNDATION AND SLAB-ON-GRADE SUBGRADE PREPARATION

SUBGRADE PREPARATION

1. The excavated footing areas shall be compacted with a hand-guided vibratory compactor having a minimum plate or drum width of 24 inches or the footing width, whichever is less. No fewer than ten (10) coverages shall be performed. Compaction tests shall be conducted to check that a density of not less than 95% of the Modified Proctor maximum dry density has been maintained.

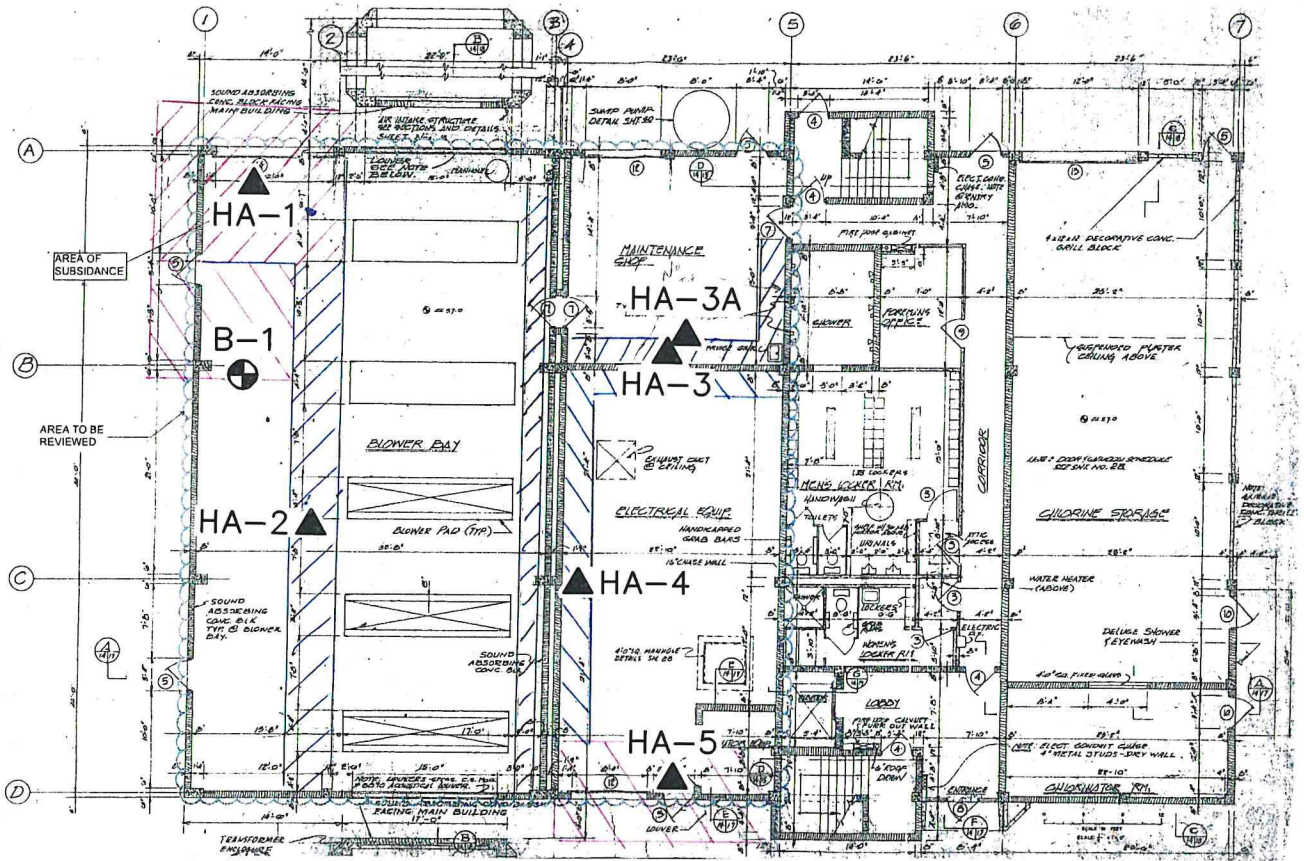
FILL OR BACKFILL PLACEMENT

1. Fill or backfill required to develop proposed grade should be inorganic, clean to slightly silty fine sand, free of unsuitable debris. Soils with a Unified Soil Classification of SP to SP-SM would certainly be considered suitable.
2. The fill should be placed in lift thicknesses not exceeding 9 inches with each lift compacted to a density of no less than 95% of the Modified Proctor maximum dry density. Moisture content within the fill soil should be controlled to within $\pm 2\%$ of optimum as established in ASTM D-1557 to help ensure development of both density and stability during compaction operations. No fewer than six (6) to eight (8) coverages should be made on each lift using the above specified heavy, vibratory roller.
3. Density tests should also be used to control fill placement. At least one (1) density test should be performed for each 2,500 ft.² per fill lift.
4. Careful inspection and compaction tests should also be performed to confirm required uniformity of compaction prior to slab-on-grade construction.

FOUNDATION DESIGN

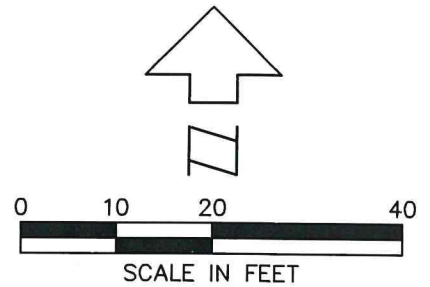
1. Shallow foundations may be designed based upon an allowable soil bearing pressure of 1,500 pounds per square foot based upon dead plus live plus wind load requirements.
2. We recommend a footing embedment of no less than 16 inches below finished grade, but excessive embedment should be avoided to take advantage of the surficial compaction.
3. Slab-on-grade construction may be utilized. To maintain slab support, excavation for utilities and foundations should be backfilled and compacted in lifts with a small compactor. Before backfill is placed, all water and loose debris should be removed from the excavations.
4. A bearing wall footing width of no less than 16 inches is recommended.

PLATE I – CORE & BORING LOCATION PLAN



LEGEND:

- ▲ HAND AUGER BORING/
HAND CONE SOUNDING LOCATION
- ⊕ STANDARD PENETRATION TEST BORING/
HAND CONE SOUNDING LOCATION



PROJECT NUMBER: DES 218838 DATE: 11/19/21

SHEET TITLE

BORING LOCATION PLAN

PREPARED BY



PROJECT NAME

**PROPOSED ELECTRICAL BUILDING
NEWWTP
CLEARWATER, FLORIDA**

SHEET NO.

PLATE I

STANDARD PENETRATION TEST (SPT) BORING LOGS



DRIGGERS ENGINEERING SERVICES INCORPORATED

Project No. DES 218838 **BORING NO. B-1**

Project Proposed Electrical Building, NEWWTP, Clearwater, Florida

Location See Plate I Foreman S.F.

Completion Depth 31.5' Date 11/12/21 Depth To Water 7.4' Time _____ Date 11/12/21

DEPTH, FT	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS ON SAMPLER PER 6" OR PEN. STR.	STANDARD PENETRATION TEST BLOWS/FT. ON 2" O.D. SAMPLER-140 LB. HAMMER, 30" DROP					
					10	20	40	60	80	
SURF. EL:										
0			6" Concrete Slab with Vapor Barrier							
			3/4" Void below Concrete Slab							
			Brown Fine SAND (SP) (A-3)							
			Light brown clayey Fine SAND (SC) (A-2-6)							
			Dark brownish-gray Fine SAND with pockets of clayey Fine SAND (SP/SC) (A-3/A-2-6)							
5			Light brown Fine SAND (SP) (A-3)							
			Gray Fine SAND (SP) (A-3)	1/1/1						
			Dark gray Fine SAND (SP) (A-3)							
			Very loose gray Fine SAND (SP) (A-3)							
			Very loose dark gray slightly silty Fine SAND with finely divided organic material and trace of roots (SP-SM) (A-3)	WH/WH/1						
10			Very loose light brown Fine SAND with pockets of clayey Fine SAND (SP/SC) (A-3/A-2-6)	3/2/1						
			Tan weathered LIMESTONE	1/1/5						
15				3/11/9						
			Hard gray variably cemented CLAY (CL) (A-7-6)							
20				15/32/50*						
			Hard light brown variably cemented CLAY with limestone fragments (CL) (A-7-6)							
25				18/19/33						
			Hard green variably cemented CLAY (CL) (A-7-6)							
30				37/31/40						

Remarks Borehole Grouted

WH = Weight of Hammer Casing Length _____

HAND AUGER BORING / HAND CONE SOUNDING LOGS



DRIGGERS ENGINEERING SERVICES INCORPORATED

HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT: Proposed Electrical Building NEWWTP Clearwater, Florida Project No.: DES 218838		CLIENT: McKim & Creed	
TECHNICIAN: S.F./G.F.		WATER TABLE: See "Note"	DATE: 11/17/21
LOCATION: See Plate I		DATE: 11/17/21	COMPLETION DEPTH: 2.6' *
		TEST NUMBER: HA-3	

ELEV. (FT)	DESCRIPTION	DEPTH (FT)	SYMBOL	HAND CONE TIP RESISTANCE (TSF)													
				0	10	20	30	40	50	60	70						
	7-1/4" Concrete Slab with Vapor Barrier	0															
	Brown Fine SAND (SP) (A-3)																
	Dark brown Fine SAND with trace of roots (SP) (A-3)	2															
	* Could not penetrate below depth 2.6' due to obstruction.																
	Note: Water Table not encountered within depth of 2.6'	4															
		6															
		8															
		10															
		12															
		14															

LEGEND:

● + Denotes Penetration Resistance in excess of 50 TSF



DRIGGERS ENGINEERING SERVICES INCORPORATED

HAND AUGER BORING/HAND CONE SOUNDING LOG											
PROJECT: Proposed Electrical Building NEWWTP Clearwater, Florida Project No.: DES 218838			CLIENT: McKim & Creed								
TECHNICIAN: S.F./G.F.			WATER TABLE: 6.2'		DATE: 11/17/21						
LOCATION: See Plate I			DATE: 11/17/21		COMPLETION DEPTH: 10.0'						
			TEST NUMBER: HA-3A								
ELEV. (FT)	DESCRIPTION	DEPTH (FT)	SYMBOL	HAND CONE TIP RESISTANCE (TSF)							
				0	10	20	30	40	50	60	70
	7" Concrete Slab with Vapor Barrier	0	▲▲▲▲▲▲▲▲▲▲								
	Dark gray Fine SAND (SP) (A-3)	0.5	●●●●●●●●●●								
	Dark brown and light brown Fine SAND (SP) (A-3)	2	●●●●●●●●●●								
	Brown Fine SAND with pockets of clayey Fine SAND (SP/SC) (A-3/A-2-6)	4	▨▨▨▨▨▨▨▨▨▨								
	Dark grayish-brown Fine SAND (SP) (A-3)	5	●●●●●●●●●●								
	Dark brown and brown Fine SAND (SP) (A-3)	6	●●●●●●●●●●								
	Light brown slightly silty Fine SAND with cemented fragments (SP-SM) (A-3)	8	●●●●●●●●●●								
		10	●●●●●●●●●●								
		12									
		14									

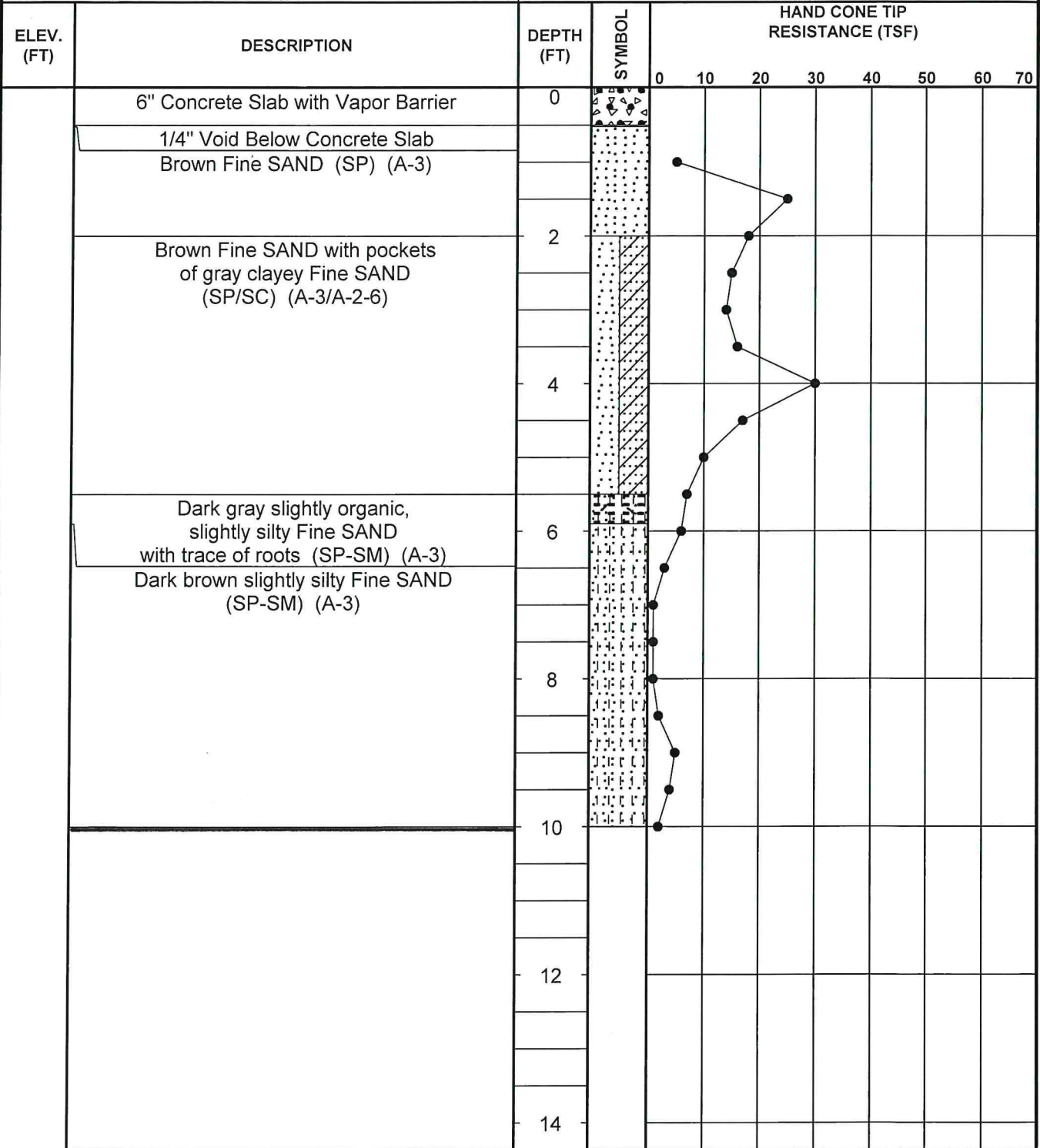
LEGEND:	● + Denotes Penetration Resistance in excess of 50 TSF
----------------	--



DRIGGERS ENGINEERING SERVICES INCORPORATED

HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT: Proposed Electrical Building NEWWTP Clearwater, Florida Project No.: DES 218838		CLIENT: McKim & Creed	
TECHNICIAN: S.F./G.F.		WATER TABLE: 6.0'	DATE: 11/17/21
LOCATION: See Plate I		DATE: 11/17/21	COMPLETION DEPTH: 10.0'
		TEST NUMBER: HA-5	



RESULTS OF GROUND PENETRATING RADAR (GPR) SURVEY

FINAL REPORT
GEOPHYSICAL INVESTIGATION
CLEARWATER NE WATER TREATMENT FACILITY SITE
CLEARWATER, FL

Prepared for Driggers Engineering Services, Inc.
Clearwater, FL

Prepared by GeoView, Inc.
St. Petersburg, FL



October 4, 2021

Mr. Wayne Driggers, P.E.
Driggers Engineering Services, Inc.
P.O. Box 17839
Clearwater, FL 33762

**Subject: Transmittal of Final Report for Geophysical Investigation
Clearwater NE Water Treatment Facility Site – Clearwater, FL
GeoView Project Number 34095**

Dear Mr. Driggers,

GeoView, Inc. (GeoView) is pleased to submit the final report that summarizes and presents the results of a geophysical investigation at the above reference site. Ground penetrating radar was used to evaluate near-surface geological conditions in this area. GeoView appreciates the opportunity to have assisted you on this project. If you have any questions or comments about the report, please contact us.

GEOVIEW, INC.

Michael J. Wightman, P.G.
Principal Geophysicist, President
Florida Professional Geologist
Number 1423

A Geophysical Services Company

*4610 Central Avenue
St. Petersburg, FL 33711*

*Tel.: (727) 209-2334
Fax: (727) 328-2477*

1.0 Introduction

A geophysical investigation was conducted on October 15, 2021 at the Clearwater NE Water Treatment plant located at 3200 State Road 580 in Clearwater, FL. The purpose of the geophysical investigation was to: 1) Determine the presence of voids underneath designated portions both inside and outside of the facility and 2) Determine the presence of karst (sinkhole) related geological features in a designated portion of the facility. The study area is shown on Figure 1 (Appendix 1).

2.0 Description of Geophysical Investigation

The GPR survey was performed along a series of perpendicular GPR transects that were spaced 2.5 feet (ft) apart. The GPR data was collected using a GSSI radar system. The GPR settings used for the survey are presented in Table 1.

Table 1
GPR Equipment Settings Used for GPR Surveys

Target of Concern	Antenna Frequency	Time Range (nano-seconds)	Estimated Depth of GPR Signal Penetration
Karst (Sinkhole)	350 MHz ^{1/}	160	20 to 30 ft bls ^{2/}
Shallow Voids	900 MHz	30	3 to 4 ft bls

1/ MHz means mega-Hertz and is the mid-range operating frequency of the GPR antenna

2/ bls means below land surface

The 350 MHz antenna was used to collect GPR data at the greatest depth possible in order to assess the potential for karst-related geological conditions. The 900 MHz antenna was used to provide a very high-resolution of near-surface soil conditions with the intent of identifying any shallow voids that might be below a concrete slab. A description of the GPR technique and the methods employed for geological characterization studies is provided in Appendix A2.2.

3.0 Identification of Possible Sinkhole and Void Features Using GPR

The features observed on GPR data that are most commonly associated with possible sinkhole and void-related conditions are:

- A downwarping of GPR reflector sets, that are associated with suspected lithological contacts, toward a common center. Such features typically have a bowl or funnel shaped configuration and can be associated with a deflection of overlying sediment horizons caused by the migration of sediments into underlying voids. If the GPR reflector

sets are sharply downwarping and intersect, they can create “bow-tie” shaped GPR reflection feature, which often designates the apparent center of the GPR anomaly.

- A localized significant increase in the depth of the penetration and/or amplitude of the GPR signal response. The increase in GPR signal penetration depth or amplitude is often associated with either a localized increase in sand content at depth or decrease in soil density.
- An apparent discontinuity in GPR reflector sets, that are associated with suspected lithological contacts. The apparent discontinuities and/or disruption of the GPR reflector sets may be associated with the downward migration sediments.
- Shallow voids are characterized by a localized increase in the amplitude of the GPR signal below the concrete slab with an associated discontinuity or disruption of the near-surface GPR reflectors.

The greater the severity of these features or a combination of these features the greater the likelihood that buried karst-related geological conditions or shallow voids are present.

4.0 Survey Results

4.1 Karst-Related Geological Conditions

Results of the GPR survey indicate the presence of two well-defined, relatively continuous sets of GPR reflectors at an approximate depth rangeS of 5 to 8 and 15 to 20 ft bls. These reflector sets are most likely associated with lithological transitions within these depth ranges.

One GPR anomaly area was identified in the northwest portion of the study area inside of the building (Figure 1). The anomaly is semi-elliptical in shape with a total area of approximately 85 square ft. The apparent vertical relief of the upper portion of the anomaly area is 1 to 2 ft as characterized by the observed downwarping of both of the previously referenced GPR reflector sets. The apparent center of the feature is characterized as the area of maximum downwarping of the previously referenced GPR reflectors.

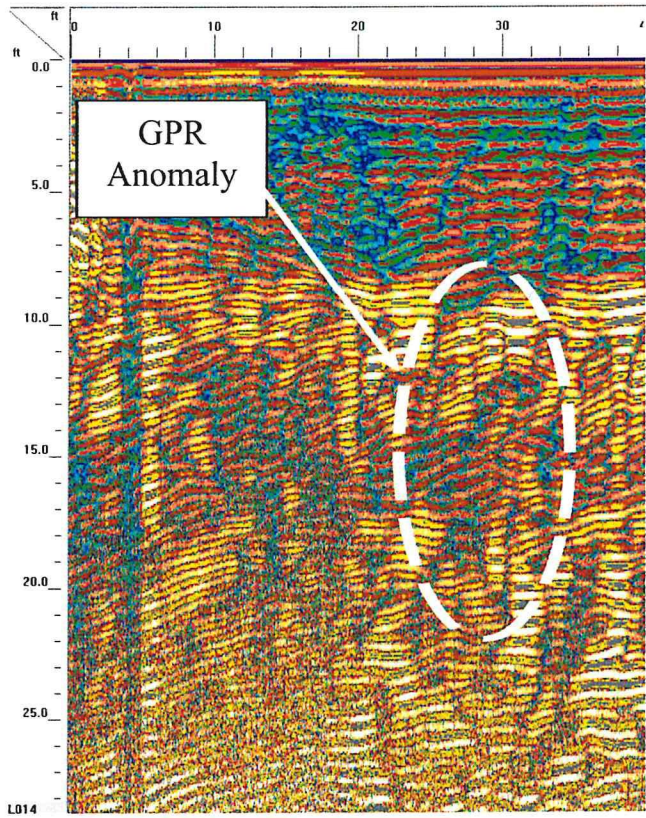
It is noted that no disruption to the sediments overlying the downwarped GPR reflectors was observed. This suggests that if the GPR anomaly is associated with a buried karst-related geological feature, that the feature has a high probability of being stable.

4.2 Shallow Voids

No indication of shallow voids were observed in the GPR data collected across the project site. This includes the area under which the GPR anomaly was observed.

Two underground utilities were identified at the project site as shown on Figure 2. An example of GPR data collected across the anomaly area is provided in Appendix 1. A discussion of the limitations of the GPR technique in geological and near-surface soil characterization studies is provided in Appendix 2.

APPENDIX 1
FIGURE AND EXAMPLE OF GPR ANOMALY



GPR Transect 14 Showing GPR Anomaly Area

APPENDIX 2

DESCRIPTION OF GEOPHYSICAL METHODS, SURVEY METHODOLOGIES AND LIMITATIONS

Ground Penetrating Radar (GPR) consists of a set of integrated electronic components that transmits high frequency (200 to 1500 megahertz [MHz]) electromagnetic waves into the ground and records the energy reflected back to the ground surface. The GPR system consists of an antenna, which serves as both a transmitter and receiver, and a profiling recorder that both processes the incoming signal and provides a graphic display of the data. The GPR data can be reviewed as both printed hard copy output or recorded on the profiling recorder's hard drive for later review. GeoView uses a Mala GPR system.

A GPR survey provides a graphic cross-sectional view of subsurface conditions. This cross-sectional view is created from the reflections of repetitive short-duration electromagnetic (EM) waves that are generated as the antenna is pulled across the ground surface. The reflections occur at the subsurface contacts between materials with differing electrical properties. The electrical property contrast that causes the reflections is the dielectric permittivity that is directly related to conductivity of a material. The GPR method is commonly used to identify such targets as underground utilities, underground storage tanks or drums, buried debris, voids or geological features.

The greater the electrical contrast between the surrounding earth materials and target of interest, the greater the amplitude of the reflected return signal. Unless the buried object is metal, only part of the signal energy will be reflected back to the antenna with the remaining portion of the signal continuing to propagate downward to be reflected by deeper features. If there is little or no electrical contrast between the target interest and surrounding earth materials it will be very difficult if not impossible to identify the object using GPR.

The depth of penetration of the GPR signal is very site specific and is controlled by two primary factors: subsurface soil conditions and selected antenna frequency. The GPR signal is attenuated (absorbed) as it passes through earth materials. As the energy of the GPR signal is diminished due to attenuation, the energy of the reflected waves is reduced, eventually to the level that the reflections can no longer be detected. As the conductivity of the earth materials increases, the attenuation of the GPR signal increases thereby reducing the signal penetration depth. In Florida, the typical soil conditions that severely limit GPR signal penetration are near-surface clays and/or organic materials.

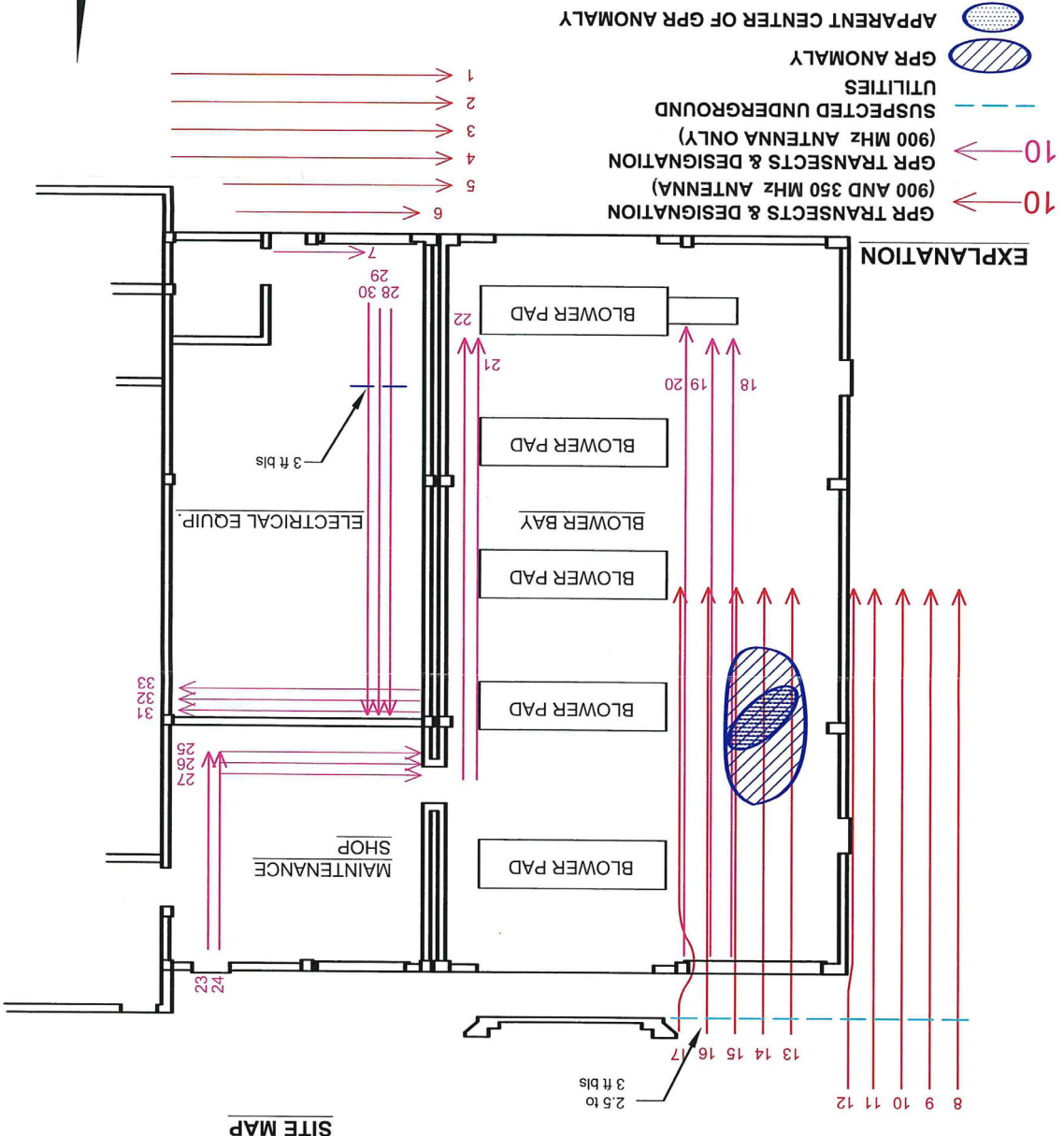


FIGURE 1
SITE MAP
SHOWING RESULTS
OF GEOPHYSICAL
INVESTIGATION

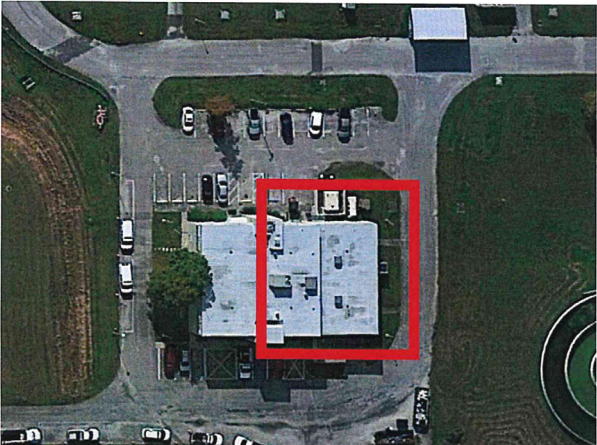
CLEARWATER NE WATER TREATMENT FACILITY SITE
3200 STATE ROAD 580
CLEARWATER, FLORIDA

DRIGERS ENGINEERING SERVICES, INC.
CLEARWATER, FLORIDA

PROJECT: 34095
DATE: 10/22/21



SITE MAP



The depth of penetration of the GPR signal is also reduced as the antenna frequency is increased. However, as antenna frequency is increased the resolution of the GPR data is improved. Therefore, when designing a GPR survey a tradeoff is made between the required depth of penetration and desired resolution of the data. As a rule, the highest frequency antenna that will still provide the desired maximum depth of penetration should be used. For exterior areas, a low-frequency (250 MHz) antenna is used. This allows for maximum signal penetration and thereby maximum depth from which information will be obtained.

A GPR survey is conducted along survey lines (transects) that are measured paths along which the GPR antenna is moved. An integrated survey wheel electronically records the distance of the GPR system along the transect lines.

For geological characterization surveys, the GPR survey is conducted along a set of perpendicularly orientated transects. The survey is conducted in two directions because subsurface features are often asymmetric. Spacing between the transects typically ranges from 10 to 50 ft. Closely spaced grids are used when the objective of the GPR survey is to identify all soil disturbances within a project site. Coarser grids are used when the objective is to provide a general overview of site conditions. After completion of a survey using a given grid spacing, additional more-closely spaced GPR transects are often performed to better characterize anomalous features identified by the initial survey. This information can be used to provide recommended locations for geotechnical borings.

Depth estimates to the top of lithological contacts or anomalous features are determined by dividing the time of travel of the GPR signal from the ground surface to the top of the feature by the velocity of the GPR signal. The velocity of the GPR signal is usually obtained from published tables of velocities for the type and condition (saturated vs. unsaturated) of soils underlying the site. The accuracy of GPR-derived depths typically ranges from 20 to 40 percent of the total depth.

Interpretation and Limitations of GPR data

The analysis and collection of GPR data is both a technical and interpretative skill. The technical aspects of the work are learned from both training and experience. Having the opportunity to compare GPR data collected in numerous settings to the results from geotechnical studies performed at the same locations develops interpretative skills for geological characterization studies.

The ability of GPR to collect interpretable information at a project site is limited by the attenuation (absorption) of the GPR signal by underlying soils. Once the GPR signal has been attenuated at a particular depth, information regarding deeper geological conditions will not be obtained. In addition, GPR data can only

resolve subsurface features that have a sufficient electrical contrast between the feature in question and surrounding earth materials. If an insufficient contrast is present, the subsurface feature will not be identified. GeoView can make no warranties or representations of geological conditions that may be present beyond the depth of investigation or resolving capability of the GPR equipment or in areas that were not accessible to the geophysical investigation.

PHOTOGRAPHS

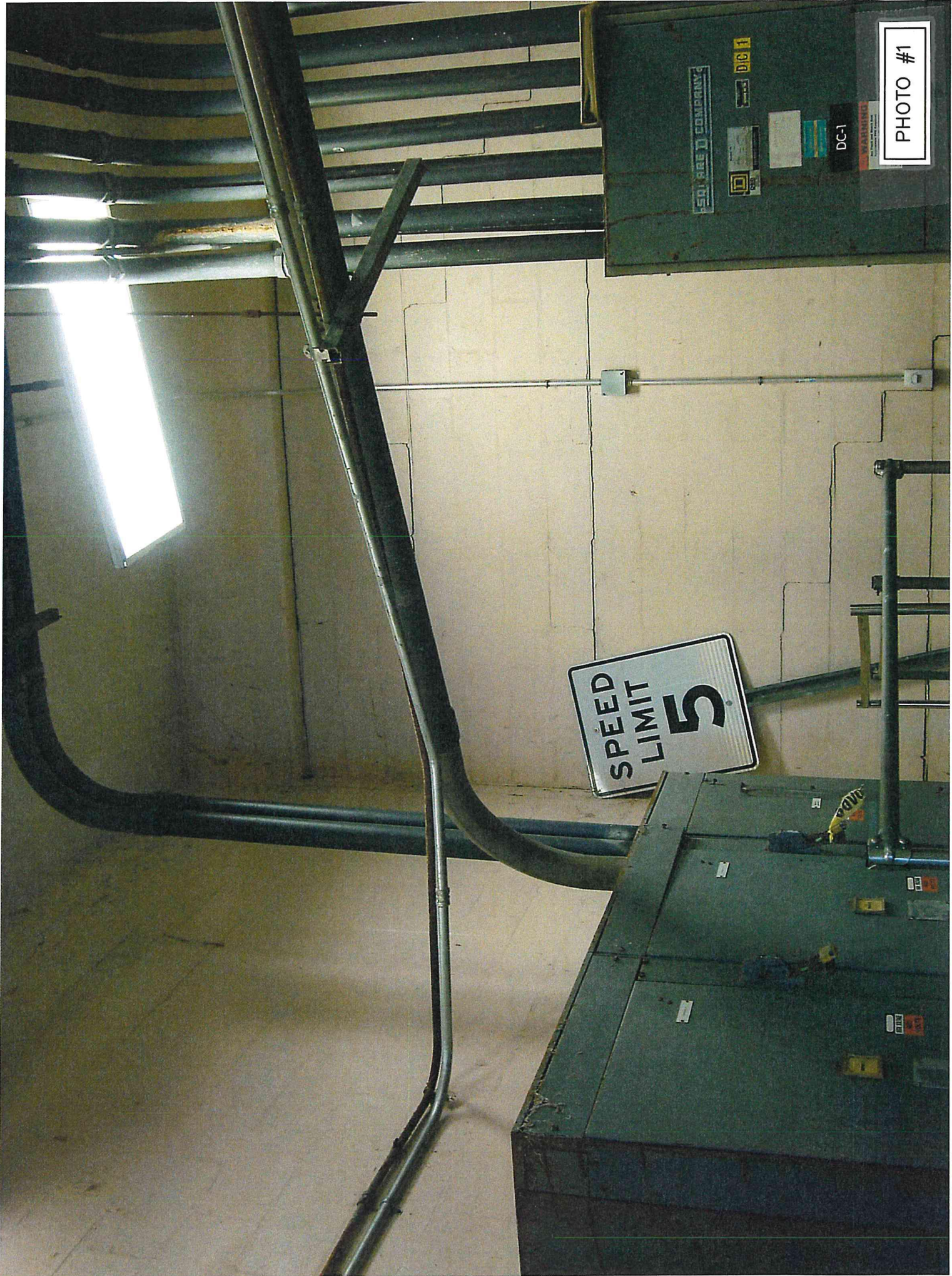


PHOTO #1

SPEED
LIMIT
5

EQUIPMENT COMPANY

DC-1

DC-1

WARNING

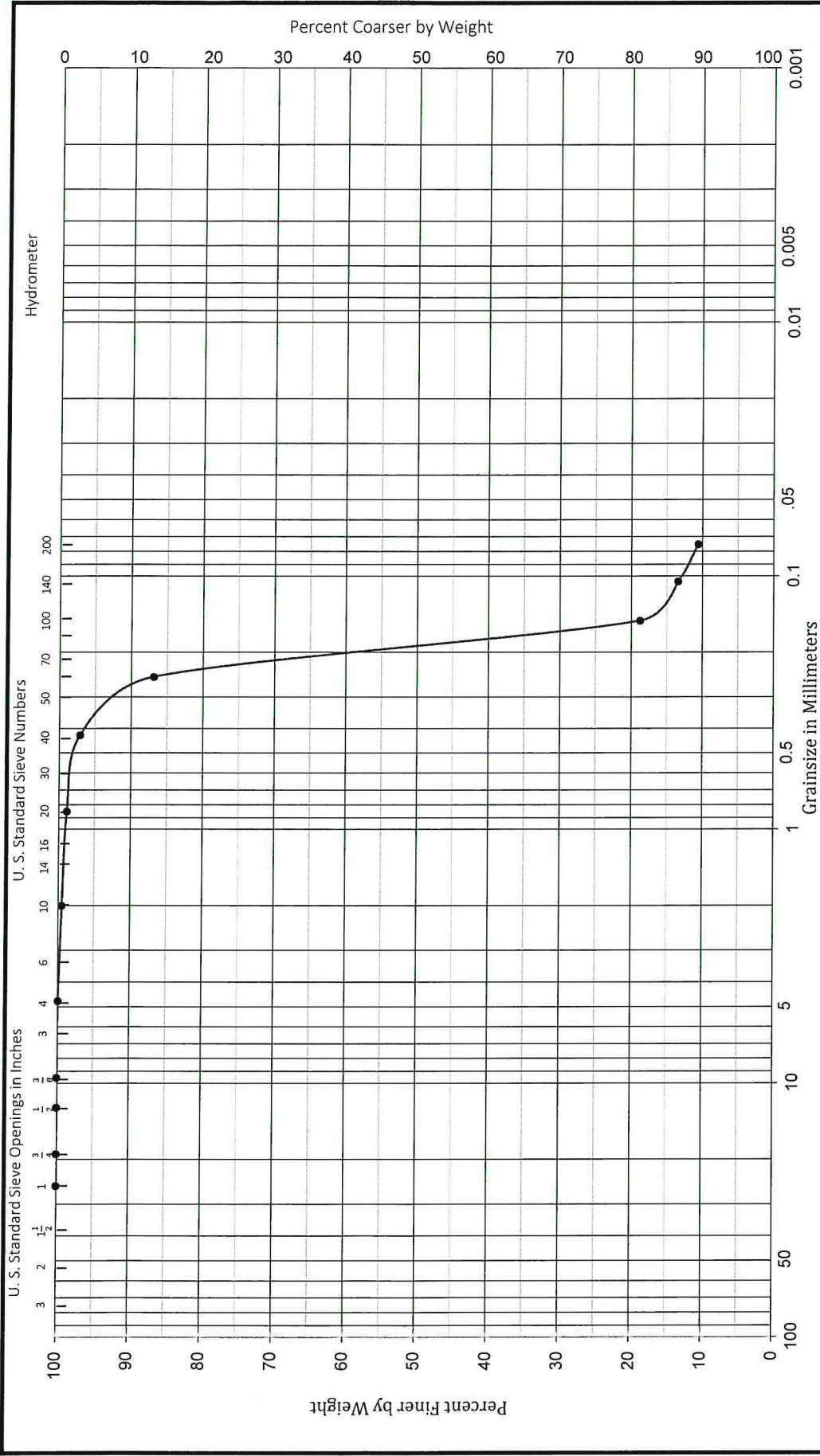
PHOTO #2



RESULTS OF LABORATORY TESTING

GRAINSIZE ANALYSES

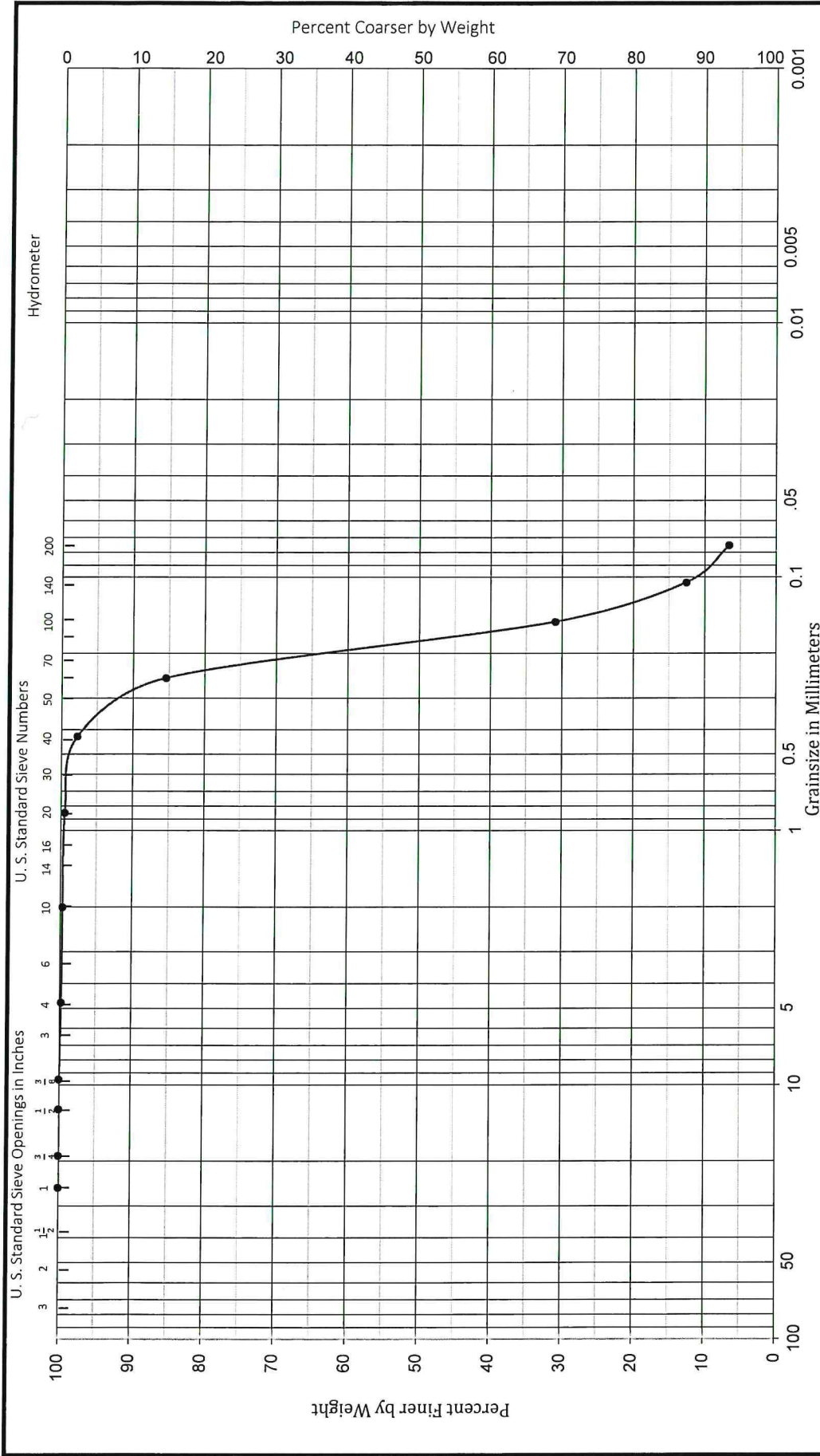
DRIGGERS ENGINEERING SERVICES, INC.



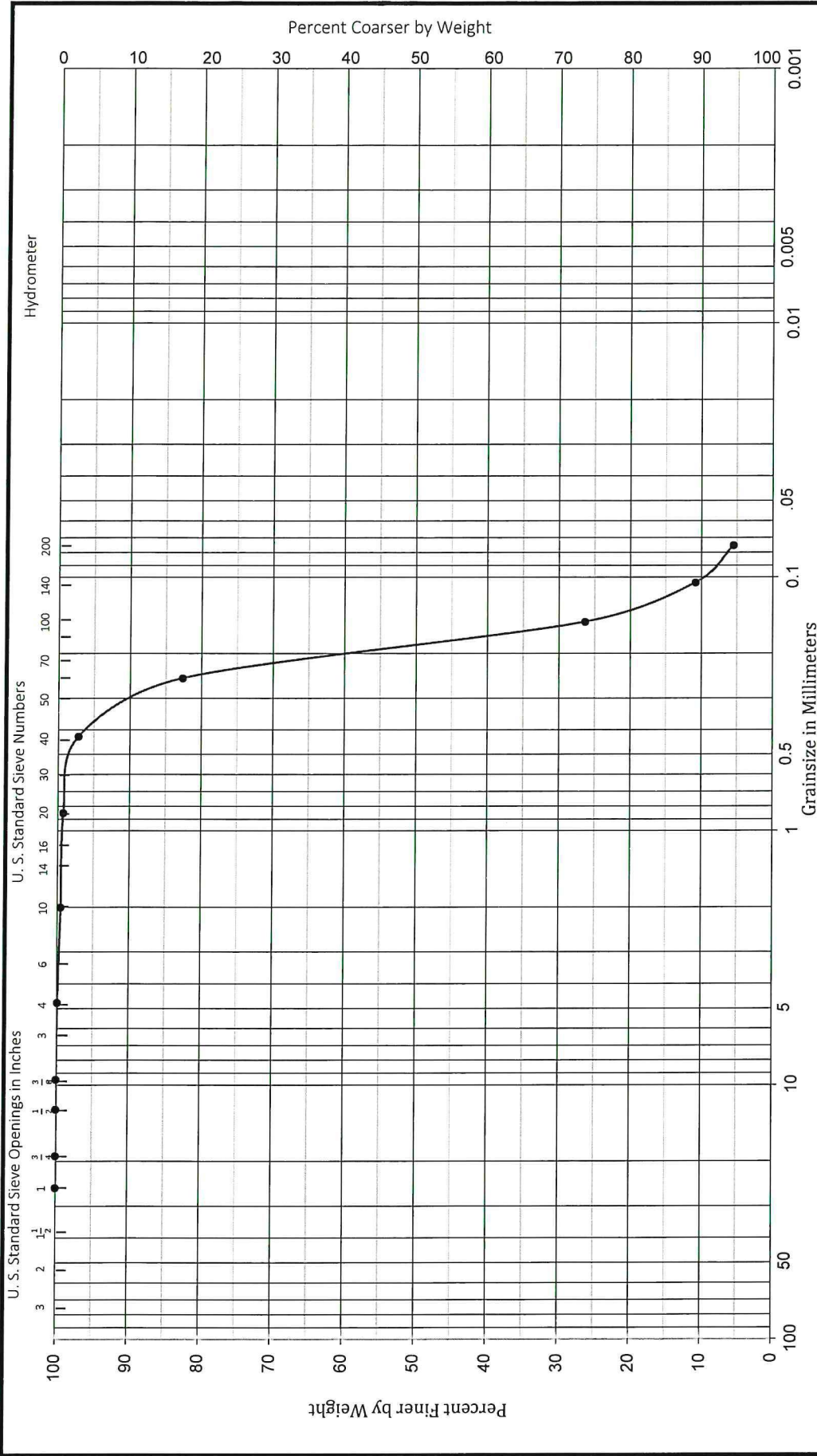
GRAVEL	SAND			SILT or CLAY
	Coarse	Medium	Fine	

Number	Depth	Moisture	L.L.	P.L.	P.I.	Classification	CLIENT:
B-1	8.0'-9.5'					Dark gray slightly silty Fine SAND with finely divided organic material and trace of roots	McKim & Creed
							PROJECT: Prop. Electrical Bldg., NEWWTP, Clearwater, FL
							FILE: DES 218838

DRIGGERS ENGINEERING SERVICES, INC.



DRIGGERS ENGINEERING SERVICES, INC.



GRAVEL		SAND		SILT or CLAY	
		Coarse	Medium	Fine	

Number	HA-4	Depth	9.5'-10.0'	Moisture		L.L.		P.L.		P.I.		Classification	Dark brown slightly silty Fine SAND with finely divided organic material	CLIENT:	McKim & Creed
														PROJECT:	Prop. Electrical Bldg., NEWWTP, Clearwater, FL
														FILE:	DES 218838

METHOD OF TESTING

STANDARD PENETRATION TEST AND SOIL CLASSIFICATION

STANDARD PENETRATION TEST (ASTM D-1586)

In the Standard Penetration Test borings, a rotary drilling rig is used to advance the borehole to the desired test depth. A viscous drilling fluid is circulated through the drill rods and bit to stabilize the borehole and to assist in removal of soil and rock cuttings up and out of the borehole.

Upon reaching the desired test depth, the 2 inch O.D. split-barrel sampler or "split-spoon", as it is sometimes called, is attached to an N-size drill rod and lowered to the bottom of the borehole. A 140 pound hammer, attached to the drill string at the ground surface, is then used to drive the sampler into the formation. The hammer is successively raised and dropped for a distance of 30 inches using a rope and "cathead" assembly. The number of blows is recorded for each 6 inch interval of penetration or until virtual refusal is achieved. In the above manner, the samples are ideally advanced a total of 18 inches. The sum of the blows required to effect the final 12 inches of penetration is called the blowcount, penetration resistance or "N" value of the particular material at the sample depth.

After penetration, the rods and sampler are retracted to the ground surface where the core sample is removed, sealed in a glass jar and transported to the laboratory for verification of field classification and storage.

SOIL SYMBOLS AND CLASSIFICATION

Soil and rock samples secured in the field sampling operation were visually classified as to texture, color and consistency. The Unified Soil Classification was assigned to each soil stratum per ASTM D-2487. Soil classifications are presented descriptively and symbolically for ease of interpretation. The stratum identification lines represent the approximate boundary between soil types. In many cases, this transition may be gradual.

Consistency of the soil as to relative density or undrained shear strength, unless otherwise noted, is based upon Standard Penetration resistance values of "N" values and industry-accepted standards. "N" values, or blowcounts, are presented in both tabular and graphical form on each respective boring log at each sample interval. The graphical plot of blowcount versus depth is for illustration purposes only and does not warrant continuity in soil consistency or linear variation between sample intervals.

The borings represent subsurface conditions at respective boring locations and sample intervals only. Variations in subsurface conditions may occur between boring locations. Groundwater depths shown represent water depths at the dates and time shown only. The absence of water table information does not necessarily imply that groundwater was not encountered.

**REPORT OF THE
SUBSURFACE SOIL INVESTIGATION**

**CONTROL BUILDING
NORTHEAST WWTP
CLEARWATER, FLORIDA**

McKim & Creed, Inc.
1365 Hamlet Avenue
Clearwater, Florida 33756

December 10, 2021

Attention: Mr. Aubrey Haudricourt,
Senior Project Engineer

**RE: Report of the Subsurface Soil Investigation
Control Building
Northeast WWTP
Clearwater, Florida
Our File: 218838**

Dear Aubrey:

In accordance with your authorization, **DRIGGERS ENGINEERING SERVICES, INC.** has conducted a limited investigation of the area of apparent slab settlement and wall cracking within the subject building. Presented herein are the results of our investigation together with recommendations for your consideration.

INVESTIGATION PROGRAM

GROUND PENETRATING RADAR SURVEY – A Ground Penetrating Radar (GPR) survey was performed by our subconsultant, GeoView, Inc. in an effort to detect voids that may be present below the bottom of the existing floor slab as well as to check for deeper anomalous conditions that could be associated with the slab settlement. The results of the GPR survey are included in the report attachments. The reader is invited to review this report for a detailed discussion of the methods of testing and findings.

STANDARD PENETRATION TEST BORING - The GPR survey identified a single deeper anomalous condition that warranted investigation. Although the GPR signal did not detect any disruption of the soils which might suggest soil raveling, a Standard Penetration Test (SPT) boring

was conducted at the center of the anomaly. The boring was advanced to a depth of 30 feet below present grade. The location of the boring is depicted on Plate I of the attachments. A log of the boring is also provided in the attachments. You will note that the upper 6 feet at the boring location was conducted utilizing hand auger equipment to refine the shallow stratigraphy as well as to check for below slab utilities that might be present. A hand cone sounding was conducted within the upper hand augered portion to provide penetration resistance data.

HAND AUGER CLASSIFICATION BORINGS – Plate I of the report illustrations identifies the respective positioning of five (5) classification borings that were performed to examine subgrade soil conditions as well as slab thickness and the presence of voids. The classification borings indicated the presence of predominantly fine sands throughout the depth of investigation. Penetration resistance values varied from very loose to medium dense in consistency. The classification borings indicate that the concrete floor slab varied in thickness to about 4 inches to 7 inches and was underlain by plastic vapor barrier. Hand cone soundings were also performed at each hand auger location. Logs of the borings are presented in the attachments.

LABORATORY TESTING - A limited laboratory classification testing program was implemented to aid in the assessment of the engineering properties of representative soils. The testing consisted of four (4) organic content tests, three (3) grainsize analyses and one (1) Atterberg Limits determination. The results of the testing are provided in the attachments. Also included are the graphical representation of the individual grainsize analyses.

INDICATED SUBSURFACE CONDITIONS

SOIL CONDITIONS - The borings were conducted through an existing slab on grade. The slab thickness ranged from about 4 to 7 inches thick with a typical thickness of about 6 inches. Below the slab, several of the borings identified a gap between the bottom of slab and soils below. The gap ranged from about ¼ inch to 1-1/2 inches. However, the ¼ inch gap could be related to the coring operation itself which uses water to advance the core barrel and may have washed out the soils slightly. The soils beneath the slab consisted of brown and gray fine sands with pockets or seams of clayey fine sand within the upper 4 to 6 feet below grade. These materials likely represent fill soils used to establish site grades or possibly backfill soils associate with below grade construction. Below these depths, dark gray sands with trace organic fines and variable root concentrations were noted at several borings. The heaviest and thickest concentration of roots

occurred at boring HA-1. This zone may represent the previous ground surface elevation prior to site filling. Below the sands with roots, brown and light brown sands with trace silt fines were encountered. The soils throughout these upper zones were generally represented by the SP to SP-SM Unified Soil Classification System (USCS) designation with occasional silty sands (SM) and clayey sands (SC) noted. The sandy soils terminated at the surface of a limestone layer beginning about 12 feet below grade at B-1. Below about 15 feet, a gray and green variably cemented clay unit was sampled to the completion depth of the boring.

Penetration resistance data suggests the soils within the upper 6 feet possess a loose to medium dense relative density. The sandy soils below that were typically very loose in relative density. The deeper clay unit was considered hard in consistency.

GROUNDWATER CONDITIONS - Groundwater levels were recorded at depths of 6 to 7.5 feet below the top of slab. It is important to note that the investigation took place during a period of low rainfall during the typical dry season.

Our review of the soils maps published by the USDA Natural Resources Conservation Service (NRCS) suggests the soils at this site are represented by the Myakka and Urban Land soil series. These soils are characterized by seasonal high groundwater levels between 6 and 18 inches below grade. However, the urban land description recognizes the site may have been regraded or filled historically. Based upon the results of our studies and current groundwater conditions, we would conservatively estimate a normal seasonal high groundwater level at about 2 to 3 feet below the top of slab elevation.

Confirmation of potential fluctuations in groundwater levels would necessitate installing shallow piezometers followed by monitoring groundwater levels throughout the remainder of the wet season.

EVALUATION

OBSERVATIONS - There were several conditions at the existing facility that warranted inspection and investigation. The following presents a summary of our observations.

1. A masonry wall separating the current maintenance shop from the electrical equipment room shows evidence of significant horizontal and stair stepped cracking (Photo #1 in the attachments). Borings HA-3 and HA-3A were performed in this area. According to the structural plans, it is our understanding there is no foundation or thickened slab beneath the wall. This wall is not load bearing.
2. Slab settlement was observed adjacent to the blower bay at the northwest corner of the structure (Photo #2) in the area of borings B-1 and HA-1. Other areas of slab settlement were noted within the electrical equipment room where heavy equipment was once reportedly located on the slab. Boring HA-4 was conducted in that area.
3. Visual inspection by others of the air plenum beneath the blower bay identified water pooled in the plenum. The depth or elevation of the water level within the plenum was not documented. Following pumping the water out, sand was observed in the bottom of the plenum on top of the base slab.

ANTICIPATED AREAS OF REMEDIATION - As previously discussed, the wall separating the maintenance shop from the electrical equipment room has cracked due to settlement of the wall. Based on the soil conditions identified, the settlement of this wall is likely due to the lack of a foundation beneath the wall. Accordingly, instead of attempting to remediate this existing non load bearing wall, the wall will be removed and reconstructed on a foundation. We would expect a wall service load on the order of 1 to 2 kips per lineal foot. It is our understanding that within the areas of slab settlement and/or where voids are detected beneath the slab, the slab will be removed and replaced. Finally, remediation of the plenum structure is expected. The top of the plenum mat slab is about 10'-6" below the finished floor according to record documents and the thickness of the mat slab is 2'-0".

NEW FOUNDATION RECOMMENDATIONS - Our geotechnical studies have identified apparent fill materials historically placed to establish current site grades. Evidence of sands containing larger roots were identified in some of the borings. However, there was no evidence of buried roots at the HA-3 or HA-3A location. The soils below about 6 feet below grade are also very loose in relative density. However, based on the relatively light loads, we would not anticipate significant settlement. Based on the above, the new wall foundation may be designed based upon an allowable net soil bearing pressure of up to 1,500 pounds per square foot. Provided proper subgrade preparation is enacted, wall foundation settlement of about 0.5 inches is expected. Due to the sandy nature of the subgrade soils, the majority of this settlement should occur quickly during construction following the imposition of load.

Included in the report attachments are specific recommendations relative to subgrade preparation and foundation design.

SLAB-ON-GRADE REPLACEMENT - There are several areas of slab subsidence. The GPR survey identified a deep anomaly that was investigated with SPT boring B-1. The SPT boring did not identify conditions consistent with sinkhole activity indicating the GPR anomaly was likely related to a slight change in the soil stratification in that area. The high frequency GPR survey to check for the presence of voids beneath the slab was unable to detect voids beneath the slab. However, cores conducted in the vicinity of slab settlement and adjacent to the air plenum identified gaps between the bottom of slab and the soils on the order ¼ inch to 1-1/2 inches in some areas. You will note that the air plenum had both water and soils present in the bottom of the structure. As discussed previously, the top of the plenum structure is about 10.5 feet below the slab on grade. Groundwater was recorded about 6 to 7.5 feet below the top of slab grade. However, the current investigation took place during the typical dry season. Based on our assessment, groundwater could rise to within a few feet below the slab on grade during the typical wet season. The presence of water and soil in the plenum suggests there is likely a breach or multiple breaches in the plenum structure allowing both soils and groundwater to migrate into the air-filled plenum. This loss of soil has likely caused the observed gaps and slab settlement noted. The deeper root zones, depending on the lateral extent of the zone, may have also contributed to the observed settlement particularly at HA-1 due to slow, long-term decomposition of the organic materials. However, any contribution associated with decomposition will diminish with time such that future settlement would be expected to be minor. Other areas where slab settlement has occurred may have been due to heavy equipment placed on a slab-on-grade that may not have been designed to carry that load.

Following removal of existing slabs to be replaced, the subgrade soils should be compacted utilizing hand-guided vibratory sled or impact compactor. The subgrade and any additional fill soils required shall be densified to not less than 95% of the Modified Proctor maximum dry density per ASTM D-1557. The fill soils should consist of fine sands comprising the SP to SP-SM Unified Soil Classification System designation. Utility trenches and ruts should be re-leveled and uniformly compacted to avoid sharp discontinuities in bearing characteristics and slab thickness that could induce cracking.

AIR PLENUM ALTERNATIVES - Based on the above, two (2) options are being contemplated. The first option is to attempt to repair and reseal the plenum structure which could be difficult to thoroughly vet all the potential soil and water access points. The second option would be to effectively abandon the plenum structure which is no longer in use. The upper structural slab above the plenum could be removed followed by placement and compaction of backfill soil materials. The backfill soils should be placed in lifts not to exceed 9 inches and compacted to not less than 95% of the Modified Proctor maximum dry density per ASTM D-1557. The back fill soils should consist of fine sands comprising the SP to SP-SM Unified Soil Classification System designation. A conventional slab-on-grade could then be constructed on the compacted backfill soils.

DRIGGERS ENGINEERING SERVICES, INC. appreciates the opportunity to assist you on this project. Should you have any questions concerning the results of our geotechnical studies, please do not hesitate to contact this office at your convenience.

Respectfully submitted,
DRIGGERS ENGINEERING SERVICES INC.

Wayne S. Driggers, P.E.
Senior Vice President
FL Registration No. 58013

WSD-REP\218806

Copies submitted: (1) email

APPENDIX

**RECOMMENDATIONS FOR FOUNDATION AND
SLAB-ON-GRADE SUBGRADE PREPARATION**

PLATE I – CORE & BORING LOCATION PLAN

STANDARD PENETRATION TEST (SPT) BORING LOGS

HAND AUGER BORING / HAND CONE SOUNDING LOGS

**REPORT OF THE GEOPHYSICAL INVESTIGATION
PREPARED BY GEO VIEW, INC.**

PHOTOGRAPHS

RESULTS OF LABORATORY TESTING

GRAINSIZE ANALYSES

METHOD OF TESTING

**RECOMMENDATIONS FOR FOUNDATION AND
SLAB-ON-GRADE SUBGRADE PREPARATION**

RECOMMENDATIONS FOR FOUNDATION AND SLAB-ON-GRADE SUBGRADE PREPARATION

SUBGRADE PREPARATION

1. The excavated footing areas shall be compacted with a hand-guided vibratory compactor having a minimum plate or drum width of 24 inches or the footing width, whichever is less. No fewer than ten (10) coverages shall be performed. Compaction tests shall be conducted to check that a density of not less than 95% of the Modified Proctor maximum dry density has been maintained.

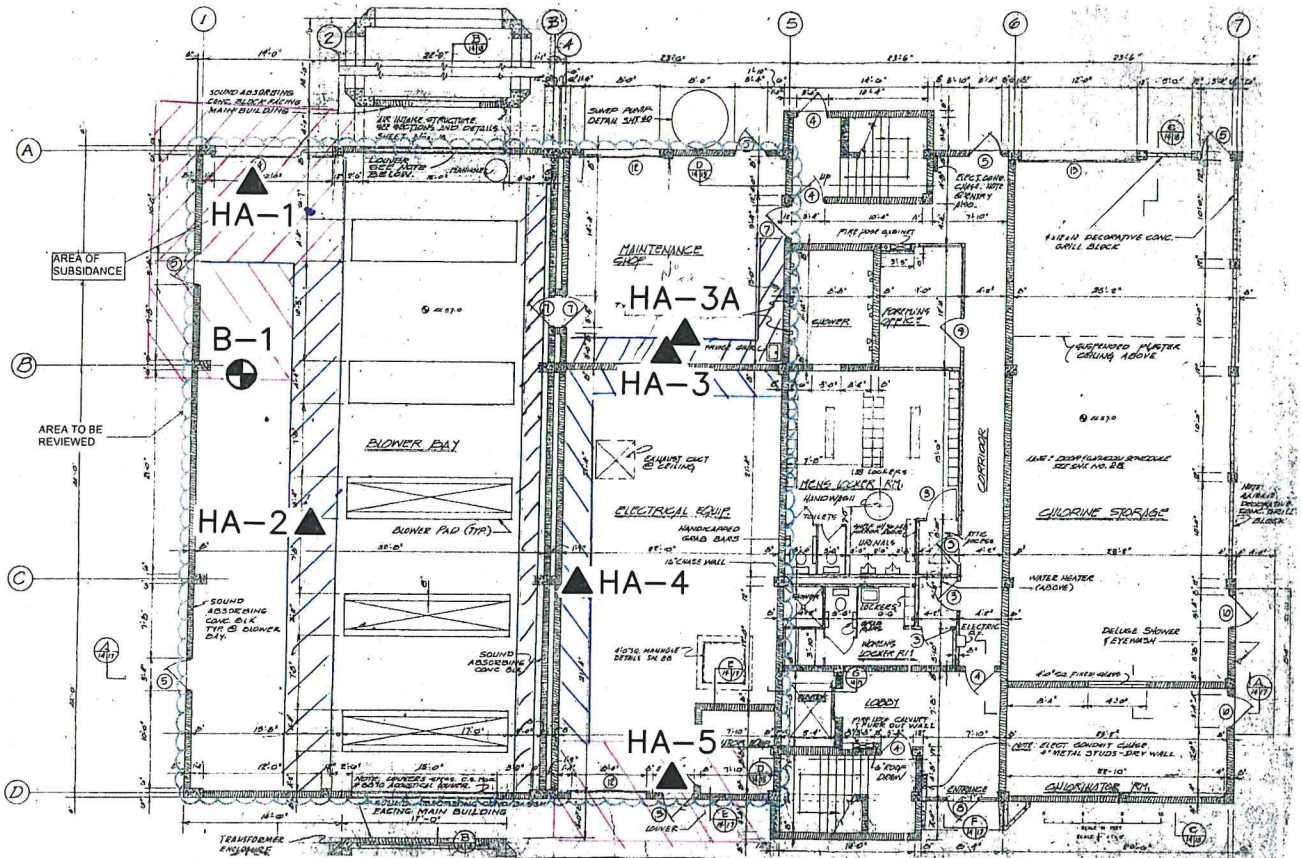
FILL OR BACKFILL PLACEMENT

1. Fill or backfill required to develop proposed grade should be inorganic, clean to slightly silty fine sand, free of unsuitable debris. Soils with a Unified Soil Classification of SP to SP-SM would certainly be considered suitable.
2. The fill should be placed in lift thicknesses not exceeding 9 inches with each lift compacted to a density of no less than 95% of the Modified Proctor maximum dry density. Moisture content within the fill soil should be controlled to within $\pm 2\%$ of optimum as established in ASTM D-1557 to help ensure development of both density and stability during compaction operations. No fewer than six (6) to eight (8) coverages should be made on each lift using the above specified heavy, vibratory roller.
3. Density tests should also be used to control fill placement. At least one (1) density test should be performed for each 2,500 ft.² per fill lift.
4. Careful inspection and compaction tests should also be performed to confirm required uniformity of compaction prior to slab-on-grade construction.

FOUNDATION DESIGN

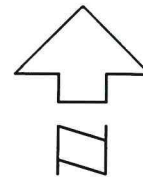
1. Shallow foundations may be designed based upon an allowable soil bearing pressure of 1,500 pounds per square foot based upon dead plus live plus wind load requirements.
2. We recommend a footing embedment of no less than 16 inches below finished grade, but excessive embedment should be avoided to take advantage of the surficial compaction.
3. Slab-on-grade construction may be utilized. To maintain slab support, excavation for utilities and foundations should be backfilled and compacted in lifts with a small compactor. Before backfill is placed, all water and loose debris should be removed from the excavations.
4. A bearing wall footing width of no less than 16 inches is recommended.

PLATE I – CORE & BORING LOCATION PLAN



LEGEND:

- ▲ HAND AUGER BORING/
HAND CONE SOUNDING LOCATION
- ⊕ STANDARD PENETRATION TEST BORING/
HAND CONE SOUNDING LOCATION



PROJECT NUMBER: DES 218838 DATE: 11/19/21

SHEET TITLE

PREPARED BY

BORING LOCATION PLAN



DRIGGERS ENGINEERING
SERVICES, INCORPORATED

PROJECT NAME

SHEET NO.

**PROPOSED ELECTRICAL BUILDING
NEWWTP
CLEARWATER, FLORIDA**

PLATE I

STANDARD PENETRATION TEST (SPT) BORING LOGS



DRIGGERS ENGINEERING SERVICES INCORPORATED

Project No. DES 218838 **BORING NO. B-1**
 Project Proposed Electrical Building, NEWWTP, Clearwater, Florida
 Location See Plate I Foreman _____ S.F. _____
 Completion _____
 Depth 31.5' Date 11/12/21 Depth To Water 7.4' Time _____ Date 11/12/21

DEPTH, FT	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS ON SAMPLER PER 6" OR PEN. STR.	STANDARD PENETRATION TEST BLOWS/FT. ON 2" O.D. SAMPLER-140 LB. HAMMER, 30" DROP					
					10	20	40	60	80	
SURF. EL:										
0			6" Concrete Slab with Vapor Barrier							
			3/4" Void below Concrete Slab							
			Brown Fine SAND (SP) (A-3)							
			Light brown clayey Fine SAND (SC) (A-2-6)							
			Dark brownish-gray Fine SAND with pockets of clayey Fine SAND (SP/SC) (A-3/A-2-6)							
5			Light brown Fine SAND (SP) (A-3)							
			Gray Fine SAND (SP) (A-3)							
			Dark gray Fine SAND (SP) (A-3)	1/1/1						
			Very loose gray Fine SAND (SP) (A-3)							
			Very loose dark gray slightly silty Fine SAND with finely divided organic material and trace of roots (SP-SM) (A-3)	WH/WH/1						
10			Very loose light brown Fine SAND with pockets of clayey Fine SAND (SP/SC) (A-3/A-2-6)	3/2/1						
			Tan weathered LIMESTONE	1/1/5						
15				3/1/19						
			Hard gray variably cemented CLAY (CL) (A-7-6)							
20				15/32/50*						
				* 0.2' Penetration						
			Hard light brown variably cemented CLAY with limestone fragments (CL) (A-7-6)							
25				18/19/33						
			Hard green variably cemented CLAY (CL) (A-7-6)							
30				37/31/40						

Remarks Borehole Grouted
WH = Weight of Hammer Casing Length _____

HAND AUGER BORING / HAND CONE SOUNDING LOGS

HAND AUGER BORING/HAND CONE SOUNDING LOG											
PROJECT: Proposed Electrical Building NEWWTP Clearwater, Florida Project No.: DES 218838			CLIENT: McKim & Creed								
TECHNICIAN: S.F./K.A.			WATER TABLE: 7.5'		DATE: 11/12/21						
LOCATION: See Plate I			DATE: 11/12/21		COMPLETION DEPTH: 8.8' *						
			TEST NUMBER: HA-1								
ELEV. (FT)	DESCRIPTION	DEPTH (FT)	SYMBOL	HAND CONE TIP RESISTANCE (TSF)							
				0	10	20	30	40	50	60	70
	4" Concrete Slab	0	▽								
	1-1/2" Void Below Concrete Slab		▽								
	Brown Fine SAND (SP) (A-3)		•						50	+	
		2	•						50	+	
	Dark brown Fine SAND (SP) (A-3)		•	15							
			•	20							
			•	25							
	Gray Fine SAND with trace of roots (SP) (A-3)	4	•	30							
			•	35							
			•	40							
	Dark gray slightly organic Fine SAND with large roots (SP) (A-3)	6	•	45							
			•	50							
			•	55							
			•	60							
			•	65							
			•	70							
			•	75							
			•	80							
			•	85							
			•	90							
			•	95							
			•	100							
			•	105							
			•	110							
			•	115							
			•	120							
			•	125							
			•	130							
			•	135							
			•	140							
			•	145							
			•	150							
			•	155							
			•	160							
			•	165							
			•	170							
			•	175							
			•	180							
			•	185							
			•	190							
			•	195							
			•	200							
			•	205							
			•	210							
			•	215							
			•	220							
			•	225							
			•	230							
			•	235							
			•	240							
			•	245							
			•	250							
			•	255							
			•	260							
			•	265							
			•	270							
			•	275							
			•	280							
			•	285							
			•	290							
			•	295							
			•	300							
			•	305							
			•	310							
			•	315							
			•	320							
			•	325							
			•	330							
			•	335							
			•	340							
			•	345							
			•	350							
			•	355							
			•	360							
			•	365							
			•	370							
			•	375							
			•	380							
			•	385							
			•	390							
			•	395							
			•	400							
			•	405							
			•	410							
			•	415							
			•	420							
			•	425							
			•	430							
			•	435							
			•	440							
			•	445							
			•	450							
			•	455							
			•	460							
			•	465							
			•	470							
			•	475							
			•	480							
			•	485							
			•	490							
			•	495							
			•	500							
			•	505							
			•	510							
			•	515							
			•	520							
			•	525							
			•	530							
			•	535							
			•	540							
			•	545							
			•	550							
			•	555							
			•	560							
			•	565							
			•	570							
			•	575							
			•	580							
			•	585							
			•	590							
			•	595							
			•	600							
			•	605							
			•	610							
			•	615							
			•	620							
			•	625							
			•	630							
			•	635							
			•	640							
			•	645							
			•	650							
			•	655							
			•	660							
			•	665							
			•	670							
			•	675							
			•	680							

HAND AUGER BORING/HAND CONE SOUNDING LOG											
PROJECT: Proposed Electrical Building NEWWTP Clearwater, Florida Project No.: DES 218838			CLIENT: McKim & Creed WATER TABLE: 7.4' DATE: 11/12/21								
TECHNICIAN: S.F./K.A.			DATE: 11/12/21		COMPLETION DEPTH: 8.2' *						
LOCATION: See Plate I			TEST NUMBER: HA-2								
ELEV. (FT)	DESCRIPTION	DEPTH (FT)	SYMBOL	HAND CONE TIP RESISTANCE (TSF)							
				0	10	20	30	40	50	60	70
	7" Concrete Slab	0	▲▲▲▲▲								
	1" Void Below Concrete Slab		●●●●●								
	Brown Fine SAND (SP) (A-3)		●●●●●								
	Light brown Fine SAND (SP) (A-3)	2	●●●●●								
	Brown and light brown Fine SAND with pockets of clayey Fine SAND (SP/SC) (A-3/A-2-6)		●●●●●								
	Light brown Fine SAND (SP) (A-3)	4	●●●●●								
	Gray Fine SAND with trace of roots (SP) (A-3)		●●●●●								
	Dark gray slightly organic Fine SAND with large roots (SP) (A-3)	6	●●●●●								
	Brownish-gray Fine SAND with trace of roots (SP) (A-3)	8	●●●●●								
	* Could not penetrate below depth 8.2' due to Water Table.	10	●●●●●								
		12									
		14									



DRIGGERS ENGINEERING SERVICES INCORPORATED

HAND AUGER BORING/HAND CONE SOUNDING LOG											
PROJECT: Proposed Electrical Building NEWWTP Clearwater, Florida Project No.: DES 218838			CLIENT: McKim & Creed								
TECHNICIAN: S.F./G.F.			WATER TABLE: 6.2'	DATE: 11/17/21							
LOCATION: See Plate I			DATE: 11/17/21	COMPLETION DEPTH: 10.0'							
			TEST NUMBER: HA-3A								
ELEV. (FT)	DESCRIPTION	DEPTH (FT)	SYMBOL	HAND CONE TIP RESISTANCE (TSF)							
				0	10	20	30	40	50	60	70
	7" Concrete Slab with Vapor Barrier	0									
	Dark gray Fine SAND (SP) (A-3)	0									
	Dark brown and light brown Fine SAND (SP) (A-3)	2									
	Brown Fine SAND with pockets of clayey Fine SAND (SP/SC) (A-3/A-2-6)	4									
	Dark grayish-brown Fine SAND (SP) (A-3)	4									
	Dark brown and brown Fine SAND (SP) (A-3)	6									
	Light brown slightly silty Fine SAND with cemented fragments (SP-SM) (A-3)	8									
		10									
		12									
		14									

LEGEND:

• + Denotes Penetration Resistance in excess of 50 TSF

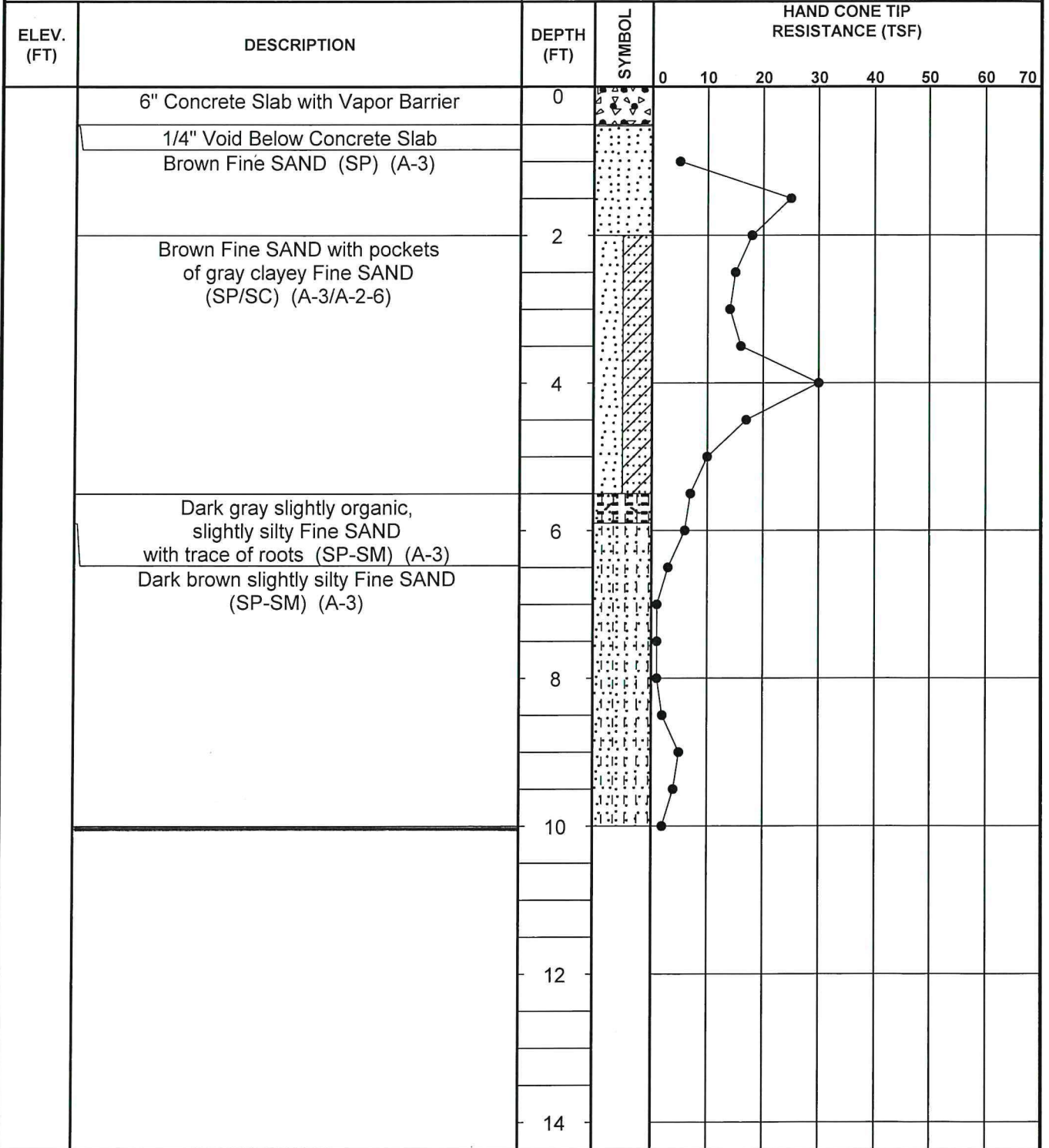
HAND AUGER BORING/HAND CONE SOUNDING LOG											
PROJECT: Proposed Electrical Building NEWWTP Clearwater, Florida Project No.: DES 218838			CLIENT: McKim & Creed								
TECHNICIAN: S.F./G.F.			WATER TABLE: 6.8'		DATE: 11/17/21						
LOCATION: See Plate I			DATE: 11/17/21		COMPLETION DEPTH: 10.0'						
			TEST NUMBER: HA-4								
ELEV. (FT)	DESCRIPTION	DEPTH (FT)	SYMBOL	HAND CONE TIP RESISTANCE (TSF)							
				0	10	20	30	40	50	60	70
	6" Concrete Slab with Vapor Barrier	0	[Symbol]								
	Dark brown Fine SAND with pockets of gray clayey Fine SAND (SP/SC) (A-3/A-2-6)	2	[Symbol]			20					
	Brown Fine SAND (SP) (A-3)	4	[Symbol]				30				
	Dark brown slightly silty Fine SAND (SP-SM) (A-3)	6	[Symbol]								
	Dark brown slightly organic, slightly silty Fine SAND (SP-SM) (A-3)	8	[Symbol]								
	Dark brown slightly silty Fine SAND with finely divided organic material (SP-SM) (A-3)	10	[Symbol]								
		12									
		14									

LEGEND:

- + Denotes Penetration Resistance in excess of 50 TSF

HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT: Proposed Electrical Building NEWWTP Clearwater, Florida Project No.: DES 218838	CLIENT: McKim & Creed WATER TABLE: 6.0' DATE: 11/17/21
TECHNICIAN: S.F./G.F.	DATE: 11/17/21 COMPLETION DEPTH: 10.0'
LOCATION: See Plate I	TEST NUMBER: HA-5



RESULTS OF GROUND PENETRATING RADAR (GPR) SURVEY

FINAL REPORT
GEOPHYSICAL INVESTIGATION
CLEARWATER NE WATER TREATMENT FACILITY SITE
CLEARWATER, FL

Prepared for Driggers Engineering Services, Inc.
Clearwater, FL

Prepared by GeoView, Inc.
St. Petersburg, FL



October 4, 2021

Mr. Wayne Driggers, P.E.
Driggers Engineering Services, Inc.
P.O. Box 17839
Clearwater, FL 33762

**Subject: Transmittal of Final Report for Geophysical Investigation
Clearwater NE Water Treatment Facility Site – Clearwater, FL
GeoView Project Number 34095**

Dear Mr. Driggers,

GeoView, Inc. (GeoView) is pleased to submit the final report that summarizes and presents the results of a geophysical investigation at the above reference site. Ground penetrating radar was used to evaluate near-surface geological conditions in this area. GeoView appreciates the opportunity to have assisted you on this project. If you have any questions or comments about the report, please contact us.

GEOVIEW, INC.

Michael J. Wightman, P.G.
Principal Geophysicist, President
Florida Professional Geologist
Number 1423

A Geophysical Services Company

*4610 Central Avenue
St. Petersburg, FL 33711*

*Tel.: (727) 209-2334
Fax: (727) 328-2477*

1.0 Introduction

A geophysical investigation was conducted on October 15, 2021 at the Clearwater NE Water Treatment plant located at 3200 State Road 580 in Clearwater, FL. The purpose of the geophysical investigation was to: 1) Determine the presence of voids underneath designated portions both inside and outside of the facility and 2) Determine the presence of karst (sinkhole) related geological features in a designated portion of the facility. The study area is shown on Figure 1 (Appendix 1).

2.0 Description of Geophysical Investigation

The GPR survey was performed along a series of perpendicular GPR transects that were spaced 2.5 feet (ft) apart. The GPR data was collected using a GSSI radar system. The GPR settings used for the survey are presented in Table 1.

Table 1
GPR Equipment Settings Used for GPR Surveys

Target of Concern	Antenna Frequency	Time Range (nano-seconds)	Estimated Depth of GPR Signal Penetration
Karst (Sinkhole)	350 MHz ^{1/}	160	20 to 30 ft bls ^{2/}
Shallow Voids	900 MHz	30	3 to 4 ft bls

1/ MHz means mega-Hertz and is the mid-range operating frequency of the GPR antenna

2/ bls means below land surface

The 350 MHz antenna was used to collect GPR data at the greatest depth possible in order to assess the potential for karst-related geological conditions. The 900 MHz antenna was used to provide a very high-resolution of near-surface soil conditions with the intent of identifying any shallow voids that might be below a concrete slab. A description of the GPR technique and the methods employed for geological characterization studies is provided in Appendix A2.2.

3.0 Identification of Possible Sinkhole and Void Features Using GPR

The features observed on GPR data that are most commonly associated with possible sinkhole and void-related conditions are:

- A downwarping of GPR reflector sets, that are associated with suspected lithological contacts, toward a common center. Such features typically have a bowl or funnel shaped configuration and can be associated with a deflection of overlying sediment horizons caused by the migration of sediments into underlying voids. If the GPR reflector

sets are sharply downwarping and intersect, they can create “bow-tie” shaped GPR reflection feature, which often designates the apparent center of the GPR anomaly.

- A localized significant increase in the depth of the penetration and/or amplitude of the GPR signal response. The increase in GPR signal penetration depth or amplitude is often associated with either a localized increase in sand content at depth or decrease in soil density.
- An apparent discontinuity in GPR reflector sets, that are associated with suspected lithological contacts. The apparent discontinuities and/or disruption of the GPR reflector sets may be associated with the downward migration sediments.
- Shallow voids are characterized by a localized increase in the amplitude of the GPR signal below the concrete slab with an associated discontinuity or disruption of the near-surface GPR reflectors.

The greater the severity of these features or a combination of these features the greater the likelihood that buried karst-related geological conditions or shallow voids are present.

4.0 Survey Results

4.1 Karst-Related Geological Conditions

Results of the GPR survey indicate the presence of two well-defined, relatively continuous sets of GPR reflectors at an approximate depth ranges of 5 to 8 and 15 to 20 ft bls. These reflector sets are most likely associated with lithological transitions within these depth ranges.

One GPR anomaly area was identified in the northwest portion of the study area inside of the building (Figure 1). The anomaly is semi-elliptical in shape with a total area of approximately 85 square ft. The apparent vertical relief of the upper portion of the anomaly area is 1 to 2 ft as characterized by the observed downwarping of both of the previously referenced GPR reflector sets. The apparent center of the feature is characterized as the area of maximum downwarping of the previously referenced GPR reflectors.

It is noted that no disruption to the sediments overlying the downwarped GPR reflectors was observed. This suggests that if the GPR anomaly is associated with a buried karst-related geological feature, that the feature has a high probability of being stable.

4.2 Shallow Voids

No indication of shallow voids were observed in the GPR data collected across the project site. This includes the area under which the GPR anomaly was observed.

Two underground utilities were identified at the project site as shown on Figure 2. An example of GPR data collected across the anomaly area is provided in Appendix 1. A discussion of the limitations of the GPR technique in geological and near-surface soil characterization studies is provided in Appendix 2.

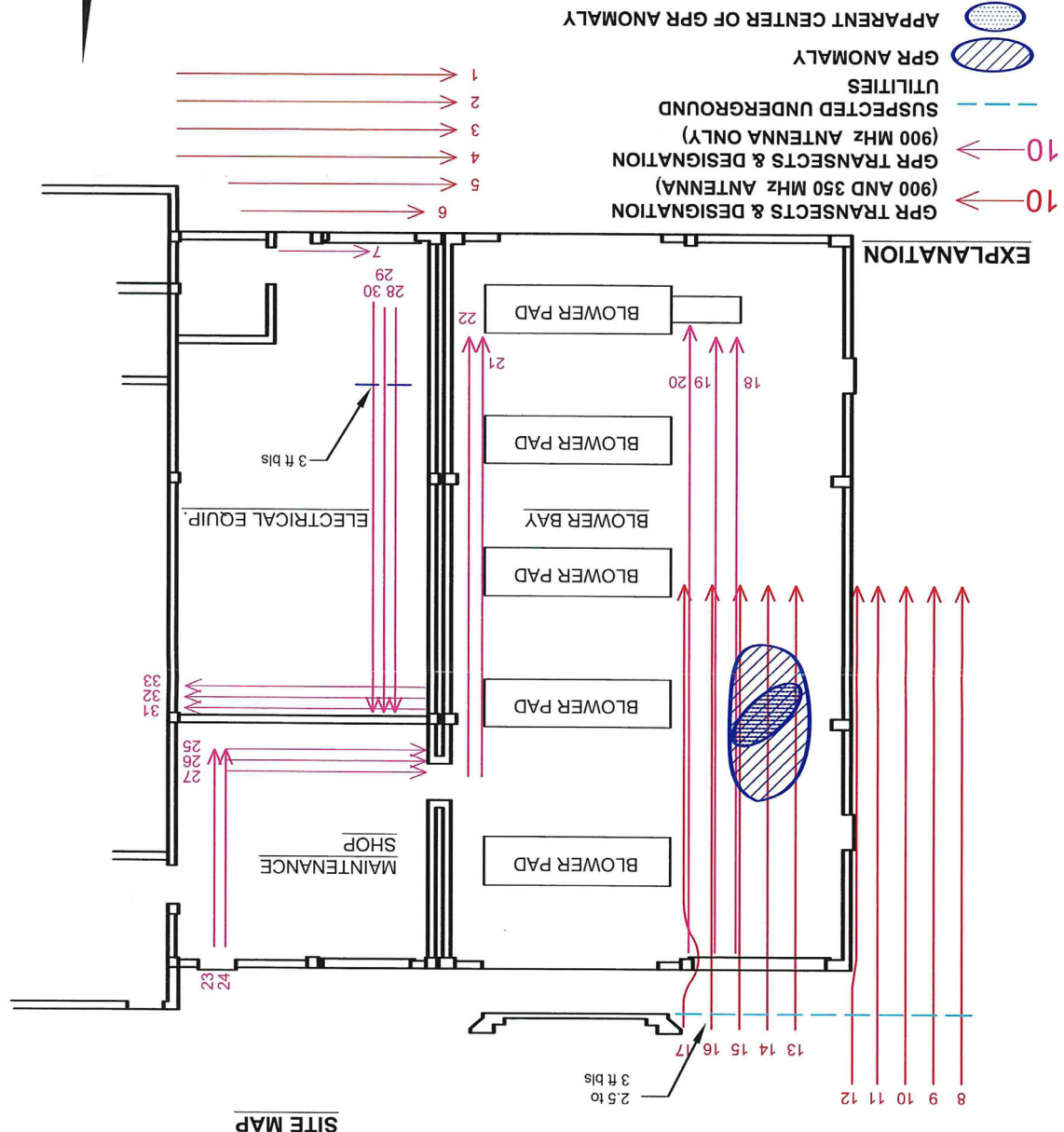
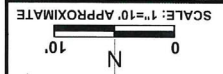
APPENDIX 1
FIGURE AND EXAMPLE OF GPR ANOMALY



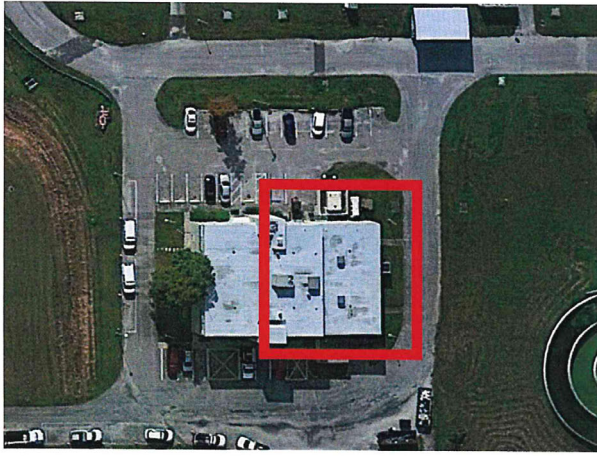
FIGURE 1
SITE MAP
SHOWING RESULTS
OF GEOPHYSICAL
INVESTIGATION

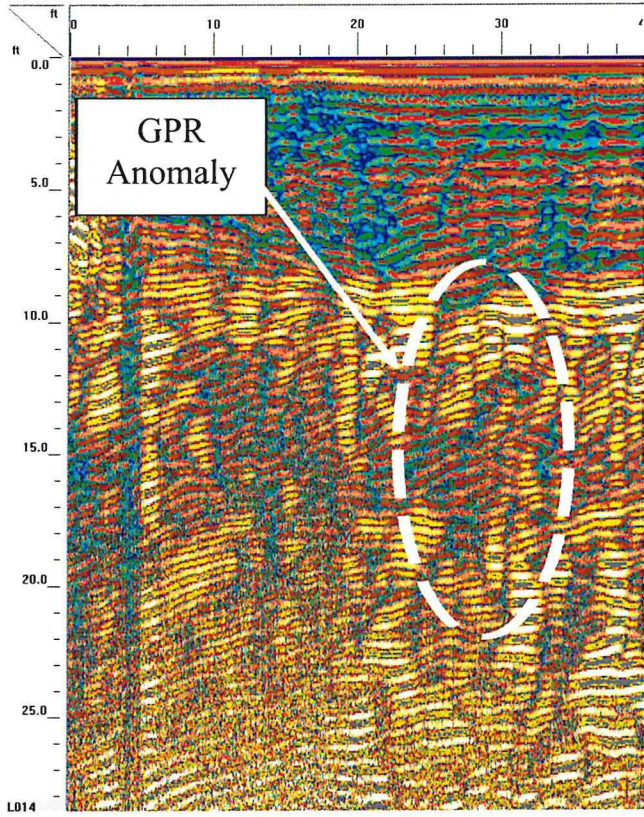
DRIGGERS ENGINEERING SERVICES, INC.
CLEARWATER, FLORIDA
PROJECT: 34095
DATE: 10/22/21

CLEARWATER NE WATER TREATMENT FACILITY SITE
3200 STATE ROAD 580
CLEARWATER, FLORIDA



SITE MAP





GPR Transect 14 Showing GPR Anomaly Area

APPENDIX 2

DESCRIPTION OF GEOPHYSICAL METHODS, SURVEY METHODOLOGIES AND LIMITATIONS

Ground Penetrating Radar (GPR) consists of a set of integrated electronic components that transmits high frequency (200 to 1500 megahertz [MHz]) electromagnetic waves into the ground and records the energy reflected back to the ground surface. The GPR system consists of an antenna, which serves as both a transmitter and receiver, and a profiling recorder that both processes the incoming signal and provides a graphic display of the data. The GPR data can be reviewed as both printed hard copy output or recorded on the profiling recorder's hard drive for later review. GeoView uses a Mala GPR system.

A GPR survey provides a graphic cross-sectional view of subsurface conditions. This cross-sectional view is created from the reflections of repetitive short-duration electromagnetic (EM) waves that are generated as the antenna is pulled across the ground surface. The reflections occur at the subsurface contacts between materials with differing electrical properties. The electrical property contrast that causes the reflections is the dielectric permittivity that is directly related to conductivity of a material. The GPR method is commonly used to identify such targets as underground utilities, underground storage tanks or drums, buried debris, voids or geological features.

The greater the electrical contrast between the surrounding earth materials and target of interest, the greater the amplitude of the reflected return signal. Unless the buried object is metal, only part of the signal energy will be reflected back to the antenna with the remaining portion of the signal continuing to propagate downward to be reflected by deeper features. If there is little or no electrical contrast between the target interest and surrounding earth materials it will be very difficult if not impossible to identify the object using GPR.

The depth of penetration of the GPR signal is very site specific and is controlled by two primary factors: subsurface soil conditions and selected antenna frequency. The GPR signal is attenuated (absorbed) as it passes through earth materials. As the energy of the GPR signal is diminished due to attenuation, the energy of the reflected waves is reduced, eventually to the level that the reflections can no longer be detected. As the conductivity of the earth materials increases, the attenuation of the GPR signal increases thereby reducing the signal penetration depth. In Florida, the typical soil conditions that severely limit GPR signal penetration are near-surface clays and/or organic materials.

The depth of penetration of the GPR signal is also reduced as the antenna frequency is increased. However, as antenna frequency is increased the resolution of the GPR data is improved. Therefore, when designing a GPR survey a tradeoff is made between the required depth of penetration and desired resolution of the data. As a rule, the highest frequency antenna that will still provide the desired maximum depth of penetration should be used. For exterior areas, a low-frequency (250 MHz) antenna is used. This allows for maximum signal penetration and thereby maximum depth from which information will be obtained.

A GPR survey is conducted along survey lines (transects) that are measured paths along which the GPR antenna is moved. An integrated survey wheel electronically records the distance of the GPR system along the transect lines.

For geological characterization surveys, the GPR survey is conducted along a set of perpendicularly orientated transects. The survey is conducted in two directions because subsurface features are often asymmetric. Spacing between the transects typically ranges from 10 to 50 ft. Closely spaced grids are used when the objective of the GPR survey is to identify all soil disturbances within a project site. Coarser grids are used when the objective is to provide a general overview of site conditions. After completion of a survey using a given grid spacing, additional more-closely spaced GPR transects are often performed to better characterize anomalous features identified by the initial survey. This information can be used to provide recommended locations for geotechnical borings.

Depth estimates to the top of lithological contacts or anomalous features are determined by dividing the time of travel of the GPR signal from the ground surface to the top of the feature by the velocity of the GPR signal. The velocity of the GPR signal is usually obtained from published tables of velocities for the type and condition (saturated vs. unsaturated) of soils underlying the site. The accuracy of GPR-derived depths typically ranges from 20 to 40 percent of the total depth.

Interpretation and Limitations of GPR data

The analysis and collection of GPR data is both a technical and interpretative skill. The technical aspects of the work are learned from both training and experience. Having the opportunity to compare GPR data collected in numerous settings to the results from geotechnical studies performed at the same locations develops interpretative skills for geological characterization studies.

The ability of GPR to collect interpretable information at a project site is limited by the attenuation (absorption) of the GPR signal by underlying soils. Once the GPR signal has been attenuated at a particular depth, information regarding deeper geological conditions will not be obtained. In addition, GPR data can only

resolve subsurface features that have a sufficient electrical contrast between the feature in question and surrounding earth materials. If an insufficient contrast is present, the subsurface feature will not be identified. GeoView can make no warranties or representations of geological conditions that may be present beyond the depth of investigation or resolving capability of the GPR equipment or in areas that were not accessible to the geophysical investigation.

PHOTOGRAPHS

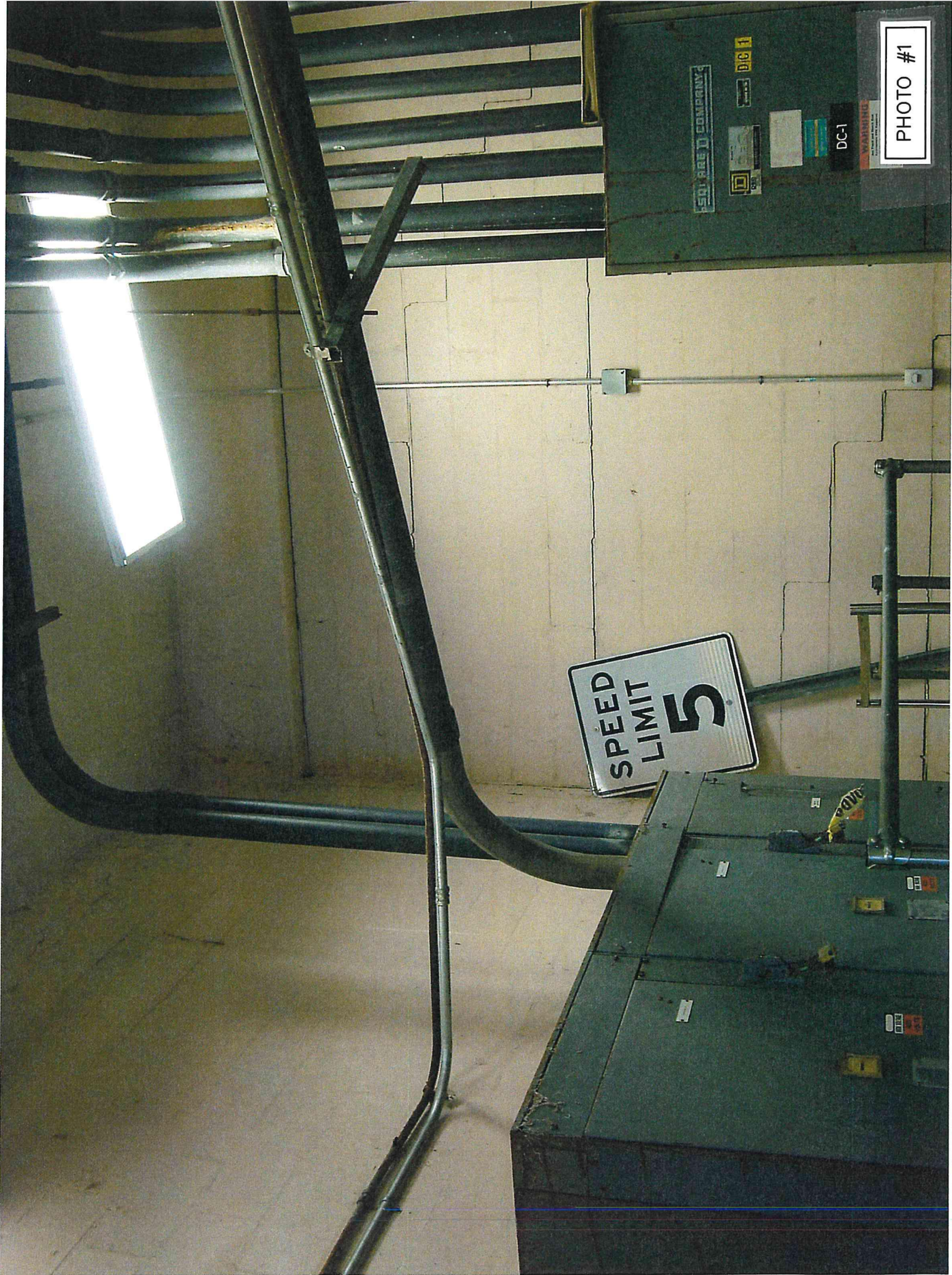


PHOTO #1

SPEED
LIMIT
5

SQUIRE COMPANY

DC-1

DC-1

WARNING

PHOTO #2



RESULTS OF LABORATORY TESTING

GRAINSIZE ANALYSES

METHOD OF TESTING

ASBESTOS REPORT

Limited Asbestos & Lead Survey

Performed at:
Clearwater Northeast Wastewater Treatment Plant
Electrical Equipment & Blower Bay Rooms
3200 Florida Route 590
Safety Harbor, FL 34698

Report Prepared For:
McKim & Creed
1365 Hamlet Avenue
Clearwater, FL 33756

Report Prepared By:

OHC Environmental Engineering, Inc.
101 South Hoover Blvd, Suite 101
Tampa, Florida 33609

OHC Project #200191-AL

November 5, 2

PROJECT INFORMATION

OHC PROJECT #: 200191-AL

CLIENT NAME: McKim & Creed

CLIENT CONTACT: Aubrey Haudricort
Senior Project Electrical Engineer

PROJECT LOCATION: Clearwater Northeast Wastewater Treatment Plant
Electrical Equipment & Blower Bay Rooms
3200 Florida Route 590
Safety Harbor, FL 34698

SERVICES: Asbestos & Lead Survey

DATE OF SURVEY: October 26, 2020

OHC SURVEYOR: Thomas Martinelli

REPORT REVIEWED BY:



Cristina Jones, CPH, MPH
OHC Operations Manager

LICENSED CONSULTANT:



James F. Rizk, CIH
FLAC #ZA0000060

TABLE OF CONTENTS

1.0	INTRODUCTION.....	1
2.0	SCOPE OF WORK.....	1
3.0	EXECUTIVE SUMMARY	1
	3.1 Asbestos Survey Results	1
	3.2 Lead Survey Results	2
4.0	ASBESTOS SURVEY	2
	4.1 Asbestos Survey Results	2
	4.2 Asbestos Sampling Methods.....	3
	4.3 Regulatory Requirements.....	4
	4.4 Statutory Requirements.....	5
5.0	LEAD SURVEY	6
	5.1 Lead Survey Results	6
	5.2 Lead Sampling Methods	7
	5.3 Standards for Lead-Containing Paint.....	7
6.0	OTHER OBSERVATIONS	8
7.0	CONCLUSIONS & RECOMMENDATIONS	8
8.0	LIMITATIONS	8
9.0	DOCUMENT CONTENT	8
	APPENDIX A: Asbestos & Lead Sampling Locations.....	9
	APPENDIX B: Photographs of Materials Sampled for Asbestos	11
	APPENDIX C: Photographs of Materials Sampled for Lead	20
	APPENDIX D: Asbestos Laboratory Analytical Results	36
	APPENDIX E: Lead Laboratory Analytical Results	43
	APPENDIX F: Consultant & Laboratory Credentials	48

1.0 INTRODUCTION

OHC Environmental Engineering, Inc., (OHC), was contracted by Aubrey Haudricort of McKim & Creed to perform an asbestos survey in compliance with the National Emission Standard for Hazardous Air Pollutants (NESHAP) regulation for asbestos (40 CFR 61 Subpart M). In addition, a survey for lead-containing paint (LCP) was performed in the areas to be disturbed. The surveys were conducted for the upcoming renovations of the electrical equipment and blower bay rooms at the Clearwater Northeast Wastewater Treatment Plant in Safety harbor, FL. A representative from OHC and certified AHERA building inspector, Mr. Thomas Martinelli, visited the site on October 26th of 2020, to perform these services.

2.0 SCOPE OF WORK

The building is a combination of offices, locker rooms, plant control room, etc. The two-story building is constructed on concrete slab at grade. Exterior load bearing walls are concrete block. The electrical equipment and blower bay rooms will be undergoing various phases of construction and renovations. The renovation will include, but are not limited to electrical equipment upgrades, floor subsidence investigations and general improvements.

3.0 EXECUTIVE SUMMARY

3.1 Asbestos Survey Results

Based on the results of the Polarized Light Microscopy (PLM) laboratory analysis, **asbestos was present** within the scope of this survey as indicated in table 1 below.

TABLE 1: ASBESTOS CONTAINING MATERIALS					
HSA	Material Locations	Material Description	Quantity, Condition, Friability	Lab Result	NESHAP Cat, OSHA Class
1	Throughout ceiling in Equipment Room and Blower Bay	White ceiling texture	2,500 SF Fair Friable	3% Chrysotile	RACM, Class I

3.2 Lead Survey Results

Based on the laboratory analysis of paint chip samples, **lead does exist** within the scope of this survey, as indicated in table 2 below.

TABLE 2: LEAD CONTAINING MATERIALS					
Sample ID	Material Locations	Material Description	Total Quantities	Result	Category
191-LP-2	Blower Bay & Equipment Room	Brown Floor Paint	2,500 SF	0.046 % wt	LCP
191-LP5	Equipment Room Garage Door	Beige paint on metal garage door	200 SF	0.22 % wt	LCP
191-LP15	Equipment Room	Locker Paint	500 SF	0.059 % wt	LCP

LCP = Lead-Containing Paint

4.0 ASBESTOS SURVEY

Based on the observations and the laboratory analysis of the samples collected from the site, **asbestos-containing materials (ACM) does exist** within the scope of this survey. The Environmental Protection Agency defines asbestos-containing material (ACM) as any material or product that contains more than one percent (1%) asbestos.

4.1 Asbestos Survey Results

Table 3 below summarizes the samples of suspect ACM collected from the site. The table describes the homogenous sampling area (HSA), sample ID, sample location, material description, quantity, condition, friability, and the laboratory analytical result. Please refer to the Appendices at the end of this report for photographs of the materials sampled and official laboratory analytical results.

LEGEND:

- NAD = No Asbestos Detected
- ### = the material contains asbestos and requires compliance with NESHAP and OSHA
- * = Quality Control sample to ensure the reliability of laboratory analytical procedures

TABLE 3: MATERIALS SAMPLED FOR ASBESTOS

HSA	Sample ID	Sample Location	Material Description	Quantity, Condition, Friability	Results
1	191-1A	Equipment Room	White Ceiling Texture	2,500 SF Fair Friable	3% Chrysotile
	191-1B	Equipment Room			
	191-1C	Equipment Room			
2	191-2A	Equipment Room	Floor Caulk/Sealant	20 SF Good Non-Friable	NAD
	191-2B	Equipment Room			
	191-2C	Equipment Room			
3	191-3A	Equipment Room	Door Caulk	300 LF Good Non-Friable	NAD
	191-3B	Blower Bay			
	191-3C	Blower Bay			
4	191-4A	Equipment Room	Brown Floor Material	2500 SF Good Non-Friable	NAD
	191-4B	Blower Bay			
	191-4C	Blower Bay			
5	191-5A	Blower Bay	Generator Insulation	300 SF Good Non-Friable	NAD
	191-5B	Blower Bay			
6	191-6A*	Blower Bay	Wall Soundproofing	Within Walls Good Friable	NAD
	191-6B	Blower Bay			
	191-6C	Blower Bay			
7	191-7A	Blower Bay	Black Pipe Coating	200 LF Good Non-Friable	NAD
	191-7B	Blower Bay			
	191-7C	Blower Bay			
8	191-8A	Blower Bay	Generator Exhaust Patch	10 SF Good Non-Friable	NAD

4.2 Asbestos Sampling Methods

Asbestos sampling was conducted in accordance with NESHAP (40 CFR 61, Subpart M) protocol for the commencement of demolition/renovation activities. The surveyor conducted a visual inspection of every safe and reasonably accessible room and space of the building. Materials sampled were grouped into Homogenous Sampling Areas (HSA) based on the texture, color, use, age, condition, and every other visual appearance to identify suspect ACM. Materials containing asbestos are grouped into the following categories:

- **Regulated ACM (RACM):** Refers to friable manufactured ACM or a Category I non-friable ACM that has become friable; or a Category I Non-Friable ACM that will be or has been subjected to sanding, grinding, cutting or abrading; or a Category II Non-Friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations.
- **Category I Non-Friable ACM:** Refers to asbestos containing packing, gaskets, resilient floor coverings (including mastics), Galbestos, and asphalt roofing products containing more than 1% asbestos.
- **Category II Non-Friable ACM:** Refers to any material that is not a Category I Non-Friable ACM that contains greater than 1% asbestos.

Bulk samples of all friable and non-friable suspect ACM were collected, as well as a representative number of samples from each homogeneous area following the EPA's simplified random sampling method (EPA560/585-030a). Good Industrial Hygiene practices were followed when collecting bulk samples in order to minimize fiber release. Every precaution was taken to prevent asbestos exposure to the surveyor, the building occupants, and the public. All sample locations were logged with an appropriate description and the locations were marked on any available drawings. A unique sequential numbering system was used to identify each area. Each bulk sample was placed in a labeled bag, which was immediately marked with its sample number. Strict Chain-of-Custody protocols were followed and signed by the receiving laboratory personnel who handled the samples. The samples were analyzed via PLM EPA-600 by EMSL Analytical in Tampa, FL. Quality control samples were analyzed by EMSL Analytical in Orlando, Florida for Quality Control procedures during the analysis of asbestos content. The purpose is to monitor the performance of the laboratories where samples are being analyzed in order to provide competence and reliability assurance.

4.3 Regulatory Requirements

Demolition: According to NESHAP, 40CFR61 Subpart M, demolition is defined as the wrecking or taking out of any load-supporting structural member of a facility together with any related handling operations or the intentional burning of any facility.

The final NESHAP Rule provides classification for regulated asbestos containing material as follows:

- Friable asbestos material;
- Category I non-friable ACM that has become friable;
- Category I non-friable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading; or
- Category II non-friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by forces expected to act upon the material in the course of demolition or renovation operations.

If the total asbestos content is determined to be trace to 10%, the owner must either assume that the material contains greater than 1% asbestos and treat the material as regulated asbestos-containing material (RACM) or have the material verified/quantified by point counting. If after point counting, the material is quantified as 1% or less, it is not regulated by the NESHAP. The Occupational Safety and Health Administration (OSHA) considers material that contains any amount of asbestos as asbestos-containing and requires compliance with OSHA regulations. The demolition of a structure with materials present that contain any amount of asbestos is considered by OSHA as an asbestos abatement, and all applicable OSHA rules must be complied with during the demolition.

Notification: Notification is required to the local regulatory agency:

1. Ten (10) working days prior to a demolition.
2. Ten (10) working days prior to a renovation operation, if the amount of asbestos material removed or impacted is greater than 160 SF on all building components (i.e. floor tile, mastic, GWBS, etc.) or 260 LF on pipes.
3. One (1) day prior to demolition, if the building has been condemned and is structurally unsound as determined by the appropriate agency.

Notification must be sent by certified mail with return receipt or hand delivered to the Florida Department of Environmental Protection. The demolition contractor must wait ten (10) working days (Monday – Friday) from the postmarked date of mailing or the date of hand delivery to commencement of demolition. Any change to the start date of the demolition requires notification to the agency by phone, followed by a written revision to the Notification Form.

4.4 Statutory Requirements

The regulatory agency responsible for the oversight of the rules pertaining to asbestos-containing building materials (ACBM) is the Environmental Protection Agency (EPA). The regulations state that prior to demolition or renovation a facility survey must be conducted in accordance to section 40 CFR 61-M National Emission Standards for Hazardous Air Pollutants; Asbestos NESHAP Revisions, Final Rule.

Enforcement of these rules was passed on to the states. In the State of Florida they are enforced by the Department of Environmental Protection (DEP). Some counties have developed an enforcement division to carry out the responsibilities of the DEP and have developed environmental and asbestos ordinances with which compliance is required.

5.0 LEAD SURVEY

Based on the laboratory analysis of paint chip samples, **lead does exist** in the areas to be disturbed.

5.1 Lead Survey Results

Table 4 below summarizes the materials tested for lead and includes their color, substrate, description and location, and lead content. Please refer to the Appendices at the end of this report for photographs of the materials sampled and official laboratory analytical results.

LEGEND:

- Samples that contains Lead at levels that will require compliance with EPA and OSHA.
- < = the analyte could not be detected at the reporting limit
- BLC = Below Levels of Concern
- **LBP = Lead-Based Paint (0.50% wt and above)**
- LCP = Lead-Containing Paint (0.49% wt and below)
- NLD = No Lead Detected

TABLE 4: LEAD CONTAINING MATERIALS					
Sample ID	Sample Location	Material Description	Quantity	Lab Result	Category
191-LP1	Equipment Room	Tan Wall Paint	5000 SF	<0.09 % wt	NLD
191-LP2	Equipment Room	Brown Floor Paint/Texture	2500 SF	0.046 % wt	LCP
191-LP3	Equipment Room	Light Grey Electrical Panel Paint	1000 SF	<0.009 % wt	NLD
191-LP4	Equipment Room	Dark Grey Electrical Panel Paint	1000 SF	<0.003 % wt	NLD
191-LP5	Equipment Room	Beige Garage Door Paint	400 SF	0.22 % wt	LCP

191-LP6	Blower Bay	Black Pipe Coating	200 LF	<0.0237% wt	NLD
191-LP7	Blower Bay	Beige Door Frame Paint	5 Frames	<0.008 % wt	NLD
191-LP8	Blower Bay	Generator Paint	Entire System	<0.032 % wt	NLD
191-LP9	Blower Bay	Tan Door Frame Paint	5 Frames	<0.027 % wt	NLD
191-LP10	Blower Bay	Green Pipe/Crane Paint	Entire System	<0.021 % wt	NLD
191-LP11	Blower Bay	Yellow Pipe Paint	200 LF	<0.009 % wt	NLD
191-LP12	Blower Bay	Orange Manhole Cover Paint	4 Manholes	<0.025 % wt	NLD
191-LP13	Blower Bay	Brown Door Paint	5 Doors	<0.015 % wt	NLD
191-LP14	Blower Bay	Black Garage Door Frame Paint	200 SF	<0.031 % wt	NLD
191-LP15	Equipment Room	Locker Paint	All Lockers	0.059 % wt	LCP

5.2 Lead Sampling Methods

All samples were collected by a trained Lead-Containing Paint inspector, placed in a sterile bag, and appropriately labeled. Strict Chain-of-Custody protocols were followed and signed by the receiving laboratory personnel who handled the samples. All samples were analyzed via Flame Atomic Absorption Spectroscopy (FAAS) by EMSL Analytical in Orlando, Florida.

5.3 Standards for Lead-Containing Paint

There is presently no standard on the level of lead in paint other than the HUD guidelines of 0.5% by weight or 1.0 mg/cm², which is used as a threshold for remedial action. OSHA, on the other hand, does not recognize these criteria. The consumer product safety commission has established a level of 0.06% as a threshold for lead-free paint. Any levels of lead in paint are considered lead-containing paint (LCP). OSHA's standards for lead are based on the potential for human exposure by means of inhalation and ingestion. Therefore, any substrate with any level of LCP could cause health concerns when the paint is disturbed. Performing activities could create airborne exposures of lead above the PEL. Any persons performing any lead activities such as LCP renovation, repair, painting, or maintenance that may disturb the paint must be certified by EPA to perform these activities in accordance with the Renovation, Repair, and Painting (RRP) rule 40 CFR 745 Subpart E.

6.0 OBSERVATIONS

- Ceiling Texture (HSA-1) was not accessible in Blower Bay due to height restrictions. The texture appears homogeneous in both rooms and was determined to be ACM.
- The floor coating/texture appears to be a vinyl-based material, which was non-ACM. However, it is coated with a brown LCP.
- Electrical Components were live. Therefore, no sampling was performed on any components. Wiring inside components appeared to be coated with non-suspect plastic or rubber.

7.0 CONCLUSIONS & RECOMMENDATIONS

Based on the results of the survey, asbestos is present in the ceiling texture located in both rooms. This material is friable, and therefore, regulated asbestos-containing material (RACM). Asbestos removal must be performed by a licensed asbestos contractor with oversight, monitoring and clearances by an industrial hygienist. Lead-containing paint (LCP) is also present on the floor, metal garage door and lockers. If the future requires full demolition of the floor coating, it should be performed under full containment by a licensed lead contractor. Spot removal may be considered on the garage door and locker. However, the method of removal is based on the client's scope for each material that contains lead and should be discussed further with the consultant. Worker exposure monitoring must also be performed to satisfy OSHA, as well as area monitoring to ensure there is no cross-contamination of asbestos fibers and lead dust.

8.0 LIMITATIONS

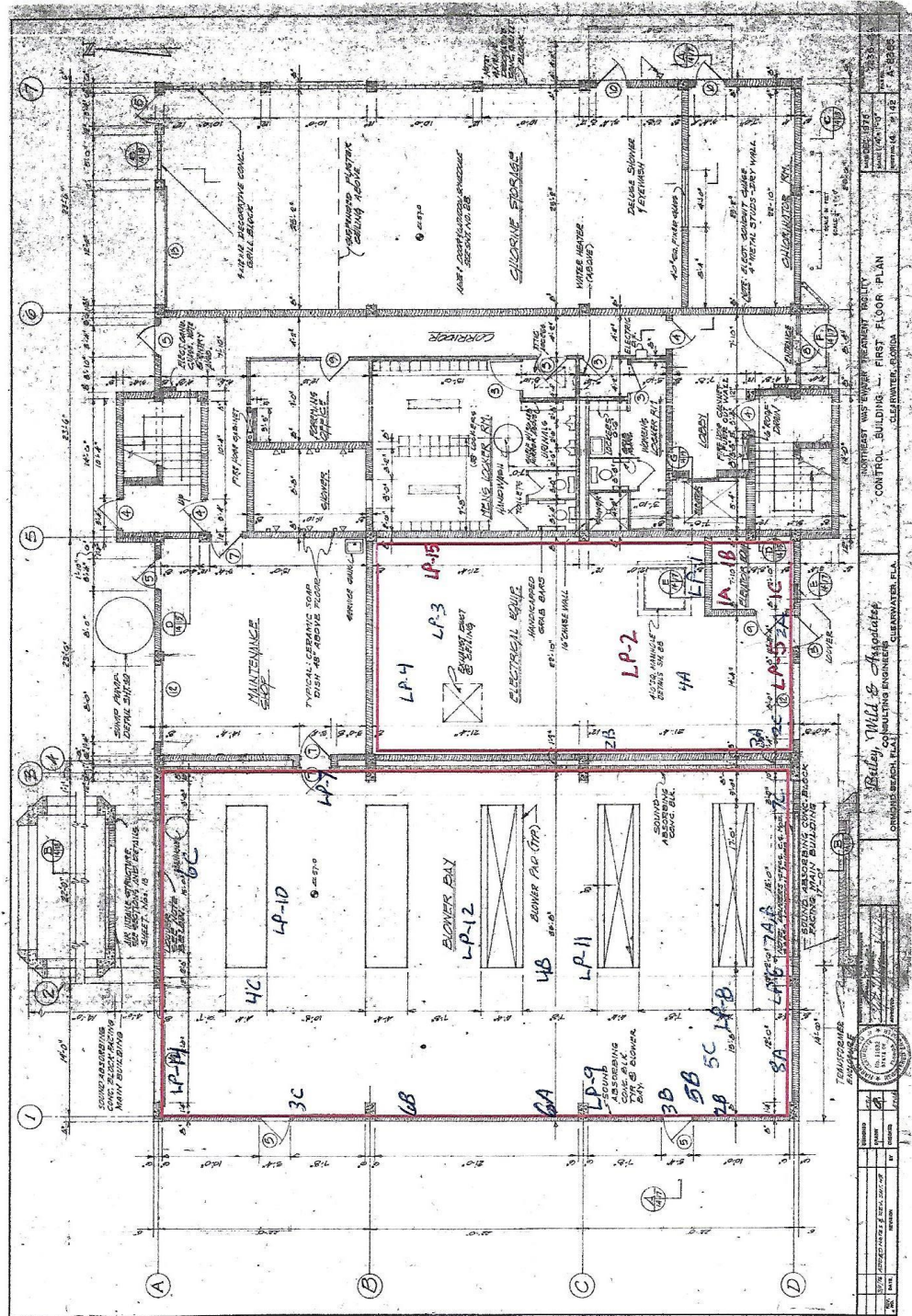
The materials sampled in this survey were subject to accessibility. OHC was unable to gain access to the ceiling in the Blower Bay room to conduct sampling, due to height restrictions. This survey is limited to equipment and blower bay rooms interior. No exterior sampling was performed. Electrical components were not disconnected. OHC warrants that the investigations and methodology reflect the prevailing standard of work practices in the environmental consulting field. If it is expected that materials outside the scope of this survey are to be disturbed, they must be presumed hazardous until the materials can be analyzed by an accredited building inspector.

9.0 DOCUMENT CONTENT

This document has been prepared for exclusive use by McKee & Kim and the Clearwater NE WWTP. The knowledge of the consultant is based upon current information and research. If local knowledge indicates error, omissions, or inaccuracy, please notify the consultant.

APPENDIX A

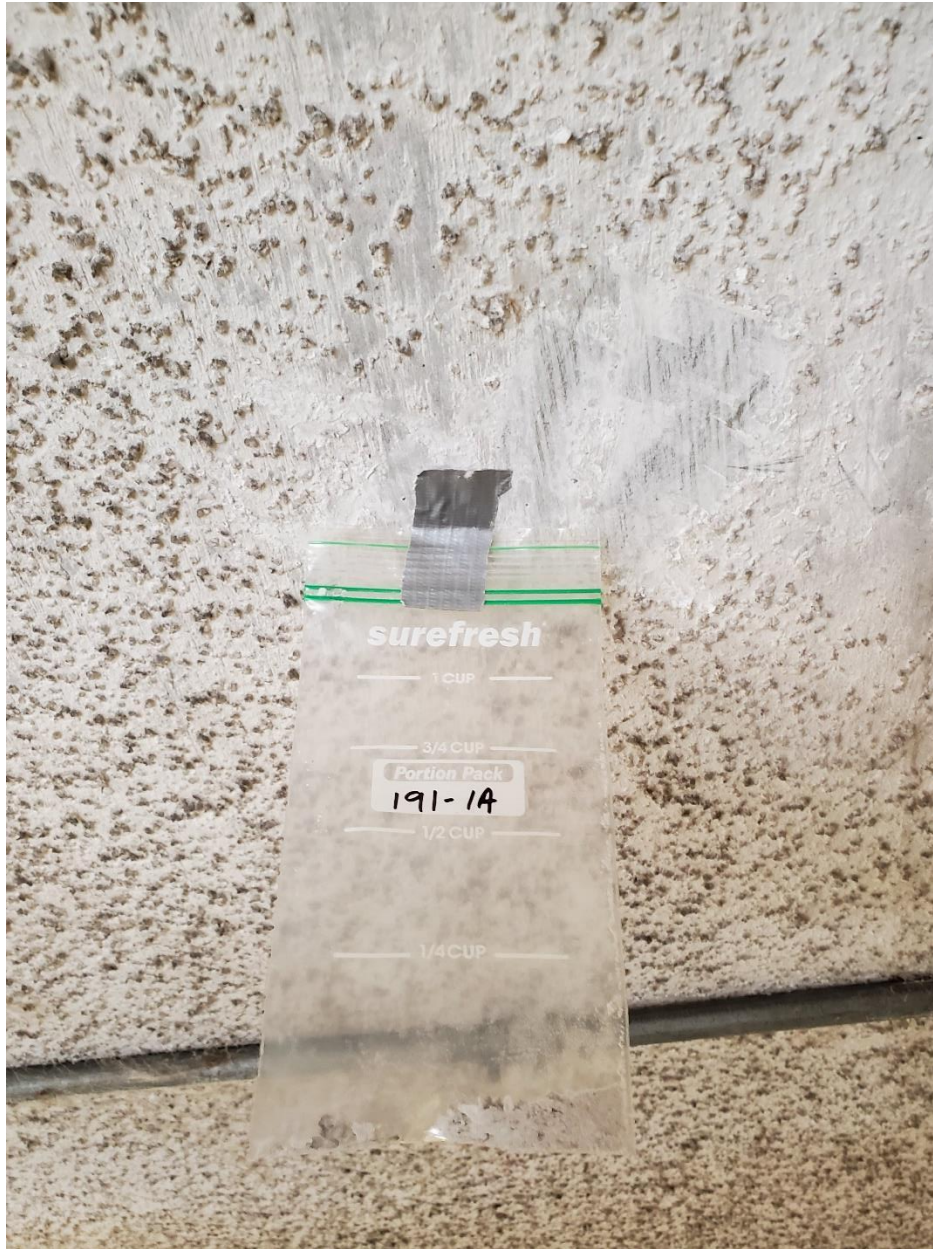
**ASBESTOS & LEAD
SAMPLING LOCATIONS**



CONTROL BUILDING - FIRST FLOOR - PLAN
 CONSULTING ENGINEER, CLEARWATER, FLA.
 Bailey, M.D. & Associates
 CONSULTING ENGINEER, CLEARWATER, FLA.

APPENDIX B

**PHOTOGRAPHS OF MATERIALS
SAMPLED FOR ASBESTOS**



191-1A: Ceiling Texture [3% Chrysotile]



191-2A: Floor Caulk/Sealant [NAD]



191-3A: Door Caulk [NAD]



1916-4A: Brown Floor Coating [NAD]



191-5A: Generator Exhaust Insulation [NAD]



191-6A: Wall Soundproofing [NAD]



191-7A: Black Pipe Coating [NAD]



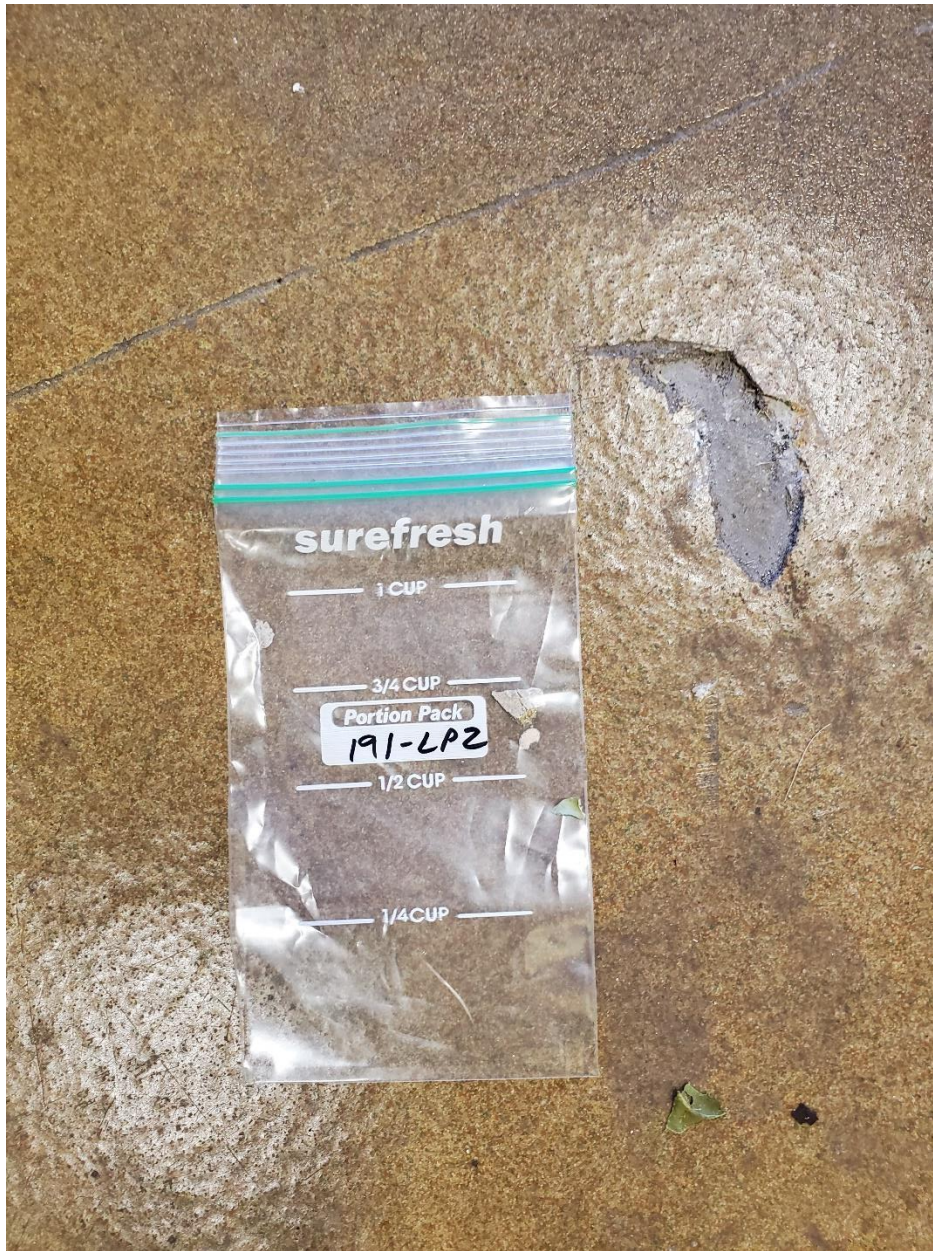
191-8A: Generator Exhaust Patch [NAD]

APPENDIX C

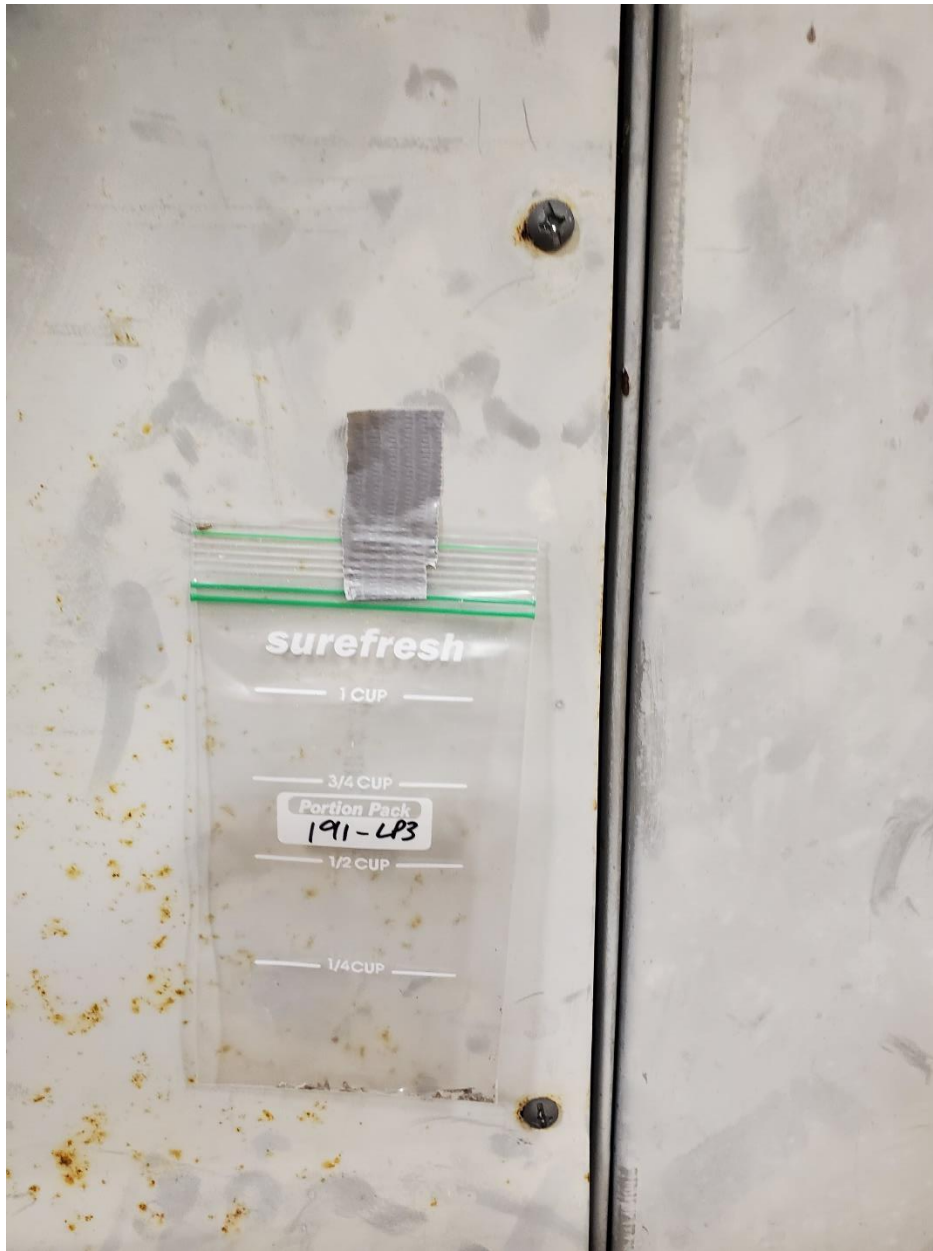
**PHOTOGRAPHS OF MATERIALS
SAMPLED FOR LEAD**



191-LP1: Tan Wall Paint on Concrete Block [NLD]



191-LP2: Brown Floor Paint/Coating [LCP]



191-LP3: Light Grey Paint on Electrical Components [NLD]



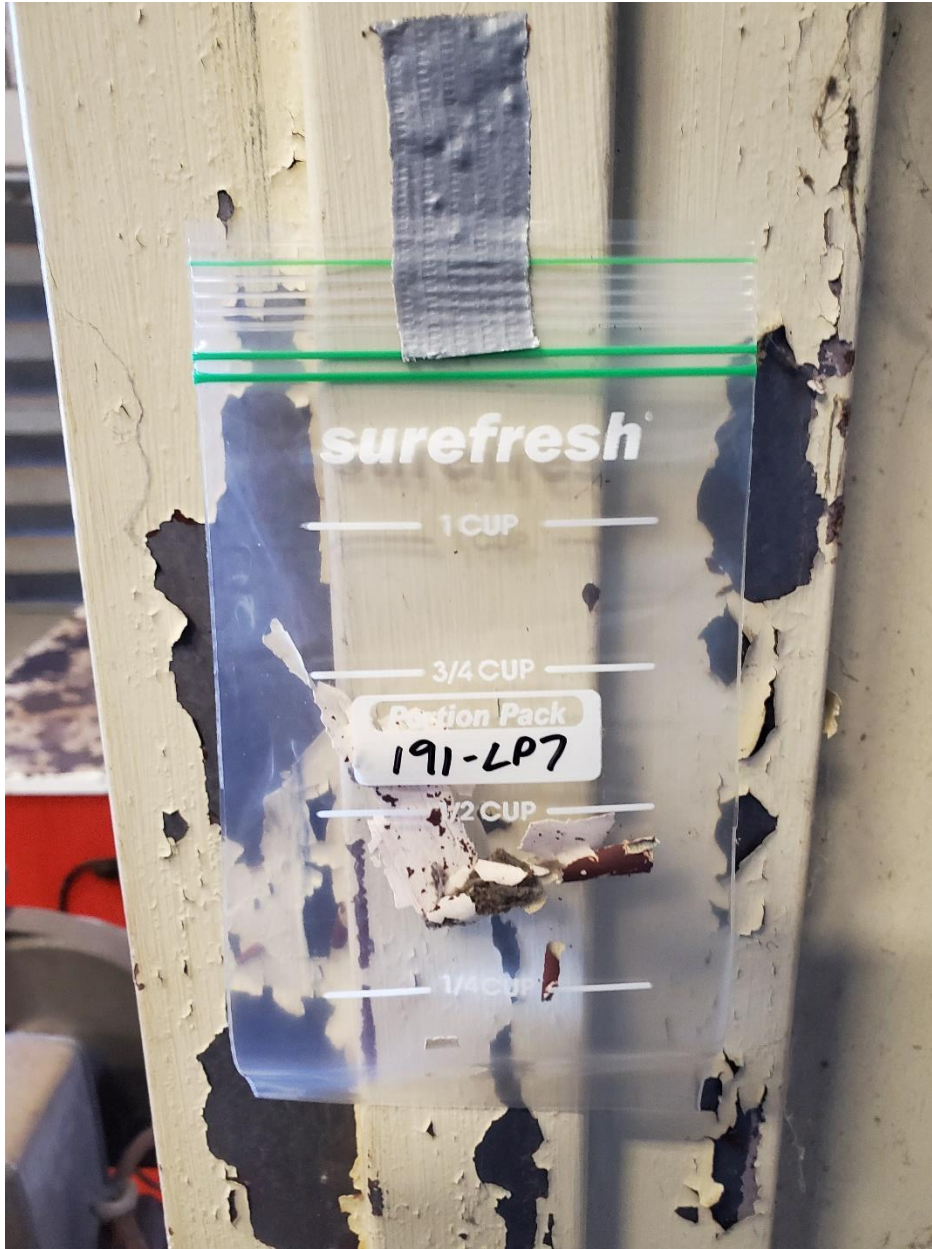
191-LP4: Dark Grey Paint on Electrical Components [NLD]



191-LP5: Beige Overhead Garage Door Paint [LCP]



191-LP6: Black Pipe Coating [NLD]



191-LP7: Beige Door Frame Paint [NAD]



191-LP8: Generator Paint [NLD]



191-LP9: Tan Door Frame Paint [NLD]



191-LP10: Green Pipe/Crane Paint [NLD]



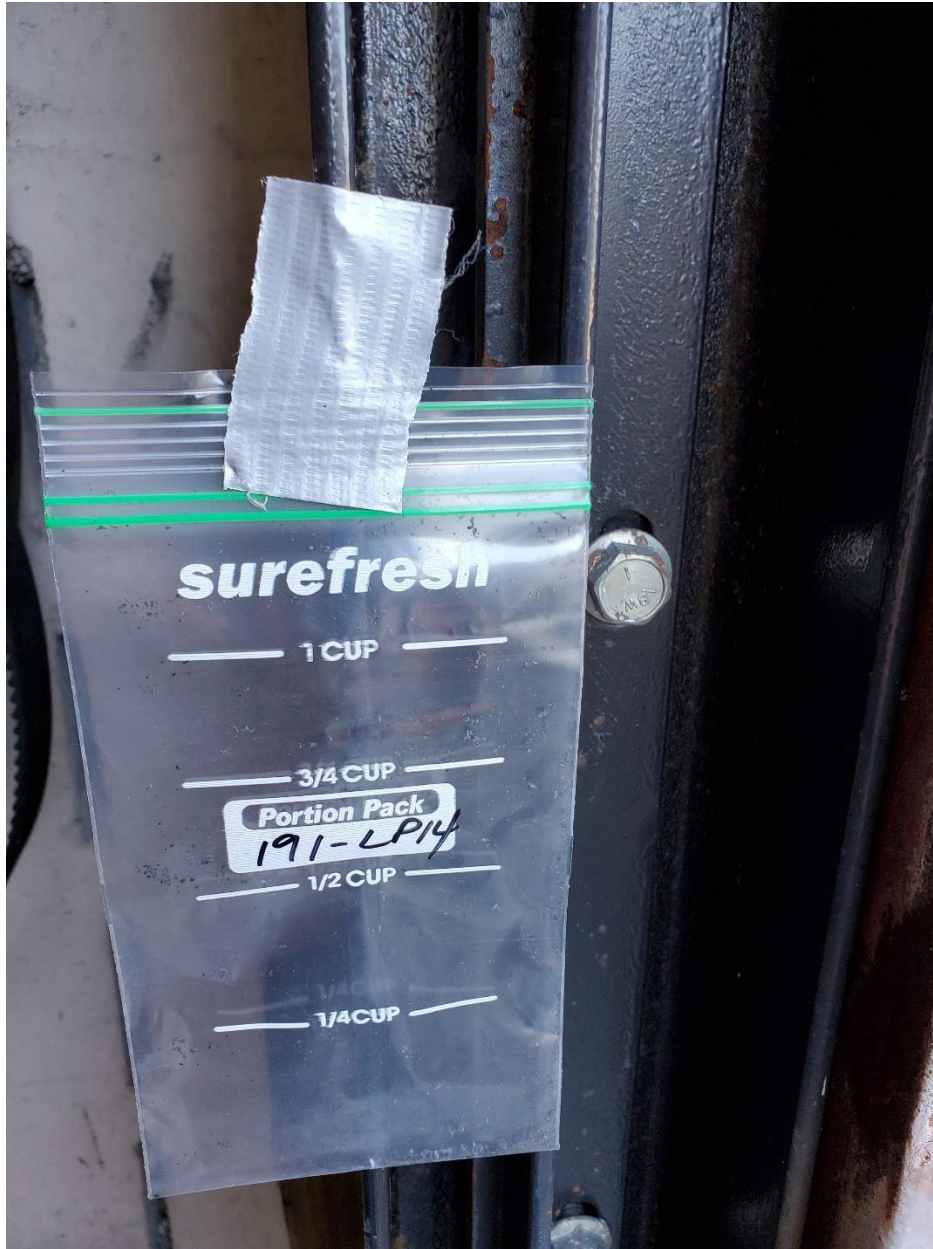
191-LP11: Yellow Pipe Paint [NLD]



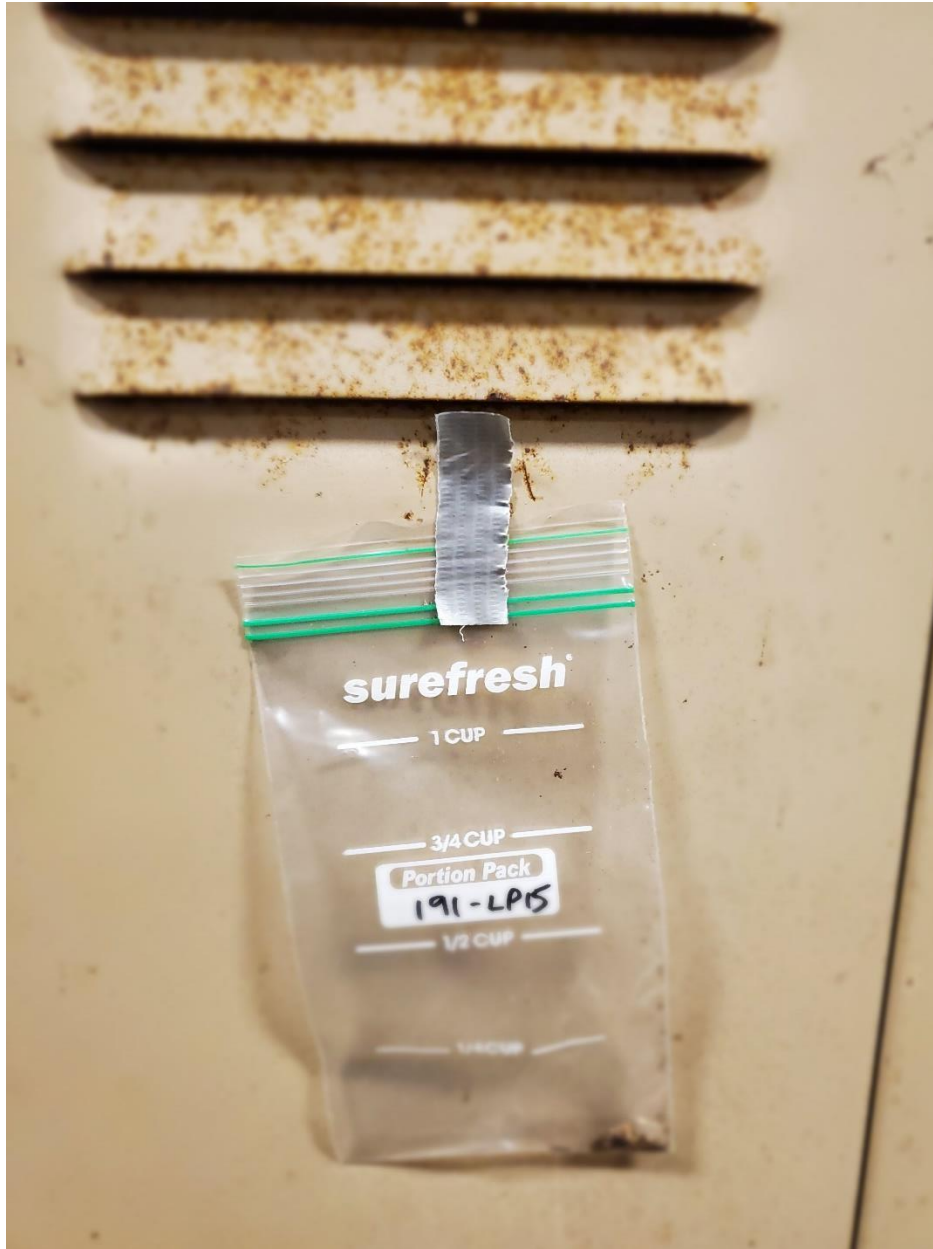
191-LP12: Orange Manhole Paint [NLD]



191-LP13: Brown Door Paint [NLD]



191-LP14: Black Garage Door Frame Paint [NLD]



191-LP15: Locker Paint [LCP]

APPENDIX D

**ASBESTOS LABORATORY
ANALYTICAL RESULTS**



EMSL Analytical, Inc.
 5700 Memorial Highway, Suite 122 Tampa, FL 33615
 Tel/Fax: (813) 280-8752 / (813) 280-8753
 http://www.EMSL.com / tampalab@emsl.com

EMSL Order: 932002302
Customer ID: OCCU56
Customer PO:
Project ID:

Attention: Tom Martinelli
 OHC Environmental Engineering, Inc.
 101 South Hoover Blvd
 Suite 101
 Tampa, FL 33609
Project: 200191-AL Clearwater NE WWTP

Phone: (813) 401-0724
Fax: (813) 623-6702
Received Date: 10/26/2020 1:19 PM
Analysis Date: 10/27/2020 - 10/28/2020
Collected Date: 10/26/2020

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
191-1A 932002302-0001	Electrical Equip Room - Ceiling Texture	White Non-Fibrous Homogeneous	HA: 1	97% Non-fibrous (Other)	3% Chrysotile
191-1B 932002302-0002	Electrical Equip Room - Ceiling Texture		HA: 1		Positive Stop (Not Analyzed)
191-1C 932002302-0003	Electrical Equip Room - Ceiling Texture		HA: 1		Positive Stop (Not Analyzed)
191-2A 932002302-0004	Electrical Equip Room - Floor Caulk/ Sealant	Gray Non-Fibrous Homogeneous	HA: 2	100% Non-fibrous (Other)	None Detected
191-2B 932002302-0005	Electrical Equip Room - Floor Caulk/ Sealant	Gray Non-Fibrous Homogeneous	HA: 2	100% Non-fibrous (Other)	None Detected
191-2C 932002302-0006	Electrical Equip Room - Floor Caulk/ Sealant	Brown/Gray/Various Non-Fibrous Homogeneous	HA: 2	5% Quartz 95% Non-fibrous (Other)	None Detected
191-3A 932002302-0007	Electrical Equip Room - Door Caulk	White Non-Fibrous Homogeneous	HA: 3	100% Non-fibrous (Other)	None Detected
191-3B 932002302-0008	Blower Bay - Door Caulk	White Non-Fibrous Homogeneous	HA: 3	100% Non-fibrous (Other)	None Detected
191-3C 932002302-0009	Blower Bay - Door Caulk	White Non-Fibrous Homogeneous	HA: 3	2% Quartz 98% Non-fibrous (Other)	None Detected
191-4A 932002302-0010	Electrical Equip Room - Brown Floor Material	Brown Non-Fibrous Homogeneous	HA: 4	100% Non-fibrous (Other)	None Detected
191-4B 932002302-0011	Blower Bay - Brown Floor Material	Brown Non-Fibrous Homogeneous	HA: 4	100% Non-fibrous (Other)	None Detected
191-4C 932002302-0012	Blower Bay - Brown Floor Material	Brown Non-Fibrous Homogeneous	HA: 4	100% Non-fibrous (Other)	None Detected

Initial report from: 10/28/2020 11:34:34





EMSL Analytical, Inc.
 5700 Memorial Highway, Suite 122 Tampa, FL 33615
 Tel/Fax: (813) 280-8752 / (813) 280-8753
 http://www.EMSL.com / tampalab@emsl.com

EMSL Order: 932002302
Customer ID: OCCU56
Customer PO:
Project ID:

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos % Type
			% Fibrous	% Non-Fibrous	
191-5A 932002302-0013	Blower Bay - Generator Insulation	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
			HA: 5		
191-5B-Insulation 932002302-0014	Blower Bay - Generator Insulation	White Non-Fibrous Homogeneous	5% Cellulose	95% Non-fibrous (Other)	None Detected
			HA: 5		
191-5B-Wrap 932002302-0014A	Blower Bay - Generator Insulation	Brown/White Fibrous Homogeneous	5% Cellulose 80% Glass	35% Non-fibrous (Other)	None Detected
			HA: 5		
191-5C 932002302-0015	Blower Bay - Generator Insulation				Not Submitted
			HA: 5		
191-6A-Wall Soundproofing 932002302-0016	Blower Bay - Wall Soundproofing	Yellow Non-Fibrous Homogeneous	70% Glass	30% Non-fibrous (Other)	None Detected
			HA: 6		
191-6A-Plaster 932002302-0016A	Blower Bay - Wall Soundproofing	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
			HA: 6		
191-6B-Wall Soundproofing 932002302-0017	Blower Bay - Wall Soundproofing	Yellow Fibrous Homogeneous	70% Glass	30% Non-fibrous (Other)	None Detected
			HA: 6		
191-6B-Plaster 932002302-0017A	Blower Bay - Wall Soundproofing	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
			HA: 6		
191-6C-Wall Soundproofing 932002302-0018	Blower Bay - Wall Soundproofing	White Fibrous Homogeneous	80% Glass	20% Non-fibrous (Other)	None Detected
			HA: 6		
191-6C-Plaster 932002302-0018A	Blower Bay - Wall Soundproofing	White Non-Fibrous Homogeneous		30% Quartz 15% Ca Carbonate 55% Non-fibrous (Other)	None Detected
			HA: 6		
191-7A 932002302-0019	Blower Bay - Black Pipe Coating	Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
			HA: 7		
191-7B 932002302-0020	Blower Bay - Black Pipe Coating	Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
			HA: 7		
191-7C 932002302-0021	Blower Bay - Black Pipe Coating	Tan/Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
			HA: 7		
191-8A 932002302-0022	Blower Bay - Generator Exhaust Patch	Gray/White/Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
			HA: 8		

Initial report from: 10/28/2020 11:34:34





EMSL Analytical, Inc.
5700 Memorial Highway, Suite 122 Tampa, FL 33615
Tel/Fax: (813) 280-8752 / (813) 280-8753
<http://www.EMSL.com> / tampalab@emsl.com

EMSL Order: 932002302
Customer ID: OCCU56
Customer PO:
Project ID:

Analyst(s)

Christopher Richardson (17)
Wyatt Brown (6)

Gerald Iannuzzi, Laboratory Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc. Tampa, FL NVLAP Lab Code 600215-0

Initial report from: 10/28/2020 11:34:34

OrderID: 932002302

932002302

ASBESTOS NESHAP CHAIN OF CUSTODY FORM



OHC Environmental Engineering, Inc.
 101 South Hoover Blvd., Suite 101
 Tampa, FL 33609
 Office: (813) 626-8156

Laboratory Name:	EMSL	
Type of Analysis:	PLM	10/26/20
Positive Stop:	YES	
Turnaround Time:	48 HR	
Total # of Samples:	22	
Date/Time Received:	10-26-20	1:19 pm
Received by (print):	G. Lamm	
Received by (sign):	<i>[Signature]</i>	

Send Report to:	Tom Martinelli	Sampled by:	T. Martinelli
Email Address:	tmartinelli@ohcnet.com	Sampling Date/Time:	10-26-20
Phone #:	813-401-0724	Relinquished by (print):	T. Martinelli
OHC Project #:	200191-AL	Relinquished by (sign):	<i>[Signature]</i>
Project Location:	Clearwater NE WWTP	Relinquished Date/Time:	10-26-20

HSA #	# of HSA Samples	Sample #	Sample Location	Material Description	Quantity	Friable Y/N
1	3	191-1A	ELECTRICAL EQUIP ROOM	CEILING	900 SF	N
		191-1B	ELECTRICAL EQUIP ROOM	TEXTURE		
		191-1C	ELECTRICAL EQUIP ROOM			
2	3	191-2A	ELECTRICAL EQUIP ROOM	FLOOR CAULK/	20 SF	N
		191-2B	ELECTRICAL EQUIP ROOM	SEALANT		
		191-2C	ELECTRICAL EQUIP ROOM			
3	3	191-3A	ELECTRICAL EQUIP ROOM	DOOR CAULK	300 LF	N
		191-3B	BLOWER BAY			
		191-3C	BLOWER BAY			
4	3	191-4A	ELECTRICAL EQUIP ROOM	BROWN FLOOR	2500 SF	N
		191-4B	BLOWER BAY	MATERIAL		
		191-4C	BLOWER BAY			
5	3	191-5A	BLOWER BAY	GENERATOR	300 SF	Y
		191-5B	BLOWER BAY	INSULATION		
		191-5C	BLOWER BAY			
6	3	191-6A	BLOWER BAY	WALL	900 SF	Y
		191-6B	BLOWER BAY	SOUNDPROOFING		
		191-6C	BLOWER BAY			
7	3	191-7A	BLOWER BAY	BLACK PIPE	200 LF	Y
		191-7B	BLOWER BAY	COATING		
		191-7C	BLOWER BAY			
8	1	191-8A	BLOWER BAY	GENERATOR EXHAUST PATCH	10 SF	N



EMSL Analytical, Inc.
 3303 PARKWAY CENTER COURT Orlando, FL 32808
 Tel/Fax: (407) 599-5887 / (407) 599-9063
 http://www.EMSL.com / orlandolab@emsl.com

EMSL Order: 342015728
Customer ID: OCCU56
Customer PO:
Project ID:

Attention: Tom Martinelli
 OHC Environmental Engineering, Inc.
 101 South Hoover Blvd
 Suite 101
 Tampa, FL 33609
Project: 200191AL Clearwater

Phone: (813) 401-0724
Fax: (813) 623-6702
Received Date: 10/27/2020 10:05 AM
Analysis Date: 10/28/2020
Collected Date:

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
191-6AD-Plaster	Blower Bay - Soundproofing	White Non-Fibrous		30% Quartz 15% Ca Carbonate	None Detected
342015728-0001		Homogeneous		55% Non-fibrous (Other)	
191-6AD-Insulation	Blower Bay - Soundproofing	Tan Fibrous	95% Min. Wool	5% Non-fibrous (Other)	None Detected
342015728-0001A		Homogeneous			

Analyst(s)
 Jason Stuhr (2)

Carlos Rivadeneyra, Laboratory Director
 or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc. Orlando, FL NVLAP Lab Code 101151-0

Initial report from: 10/28/2020 16:56:42



APPENDIX E

**LEAD LABORATORY
ANALYTICAL RESULTS**



EMSL Analytical, Inc.
 3303 PARKWAY CENTER COURT, Orlando, FL 32808
 Phone/Fax (407) 599-5887 / (407) 599-9063
<http://www.EMSL.com> orlandolab@emsl.com

EMSL Order: 342015692
 CustomerID: OCCU56
 CustomerPO:
 ProjectID:


Attn: **Tom Martinelli**
OHC Environmental Engineering, Inc.
101 South Hoover Blvd
Suite 101
Tampa, FL 33609

Phone: (813) 626-8156
 Fax: (813) 623-6702
 Received: 10/27/2020 10:05 AM
 Collected: 10/26/2020

Project: 200191-AL Clearwater NE WWTP

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	Collected	Analyzed	Weight	RDL	Lead Concentration
191-LP1 342015692-0001 Site: Electrical Equipment Room - Tan Wall Paint	10/26/2020	10/28/2020	0.0519 g	0.039 % wt	<0.039 % wt
191-LP2 342015692-0002 Site: Electrical Equipment Room - Brown Floor Paint	10/26/2020	10/28/2020	0.1575 g	0.013 % wt	0.046 % wt
191-LP3 342015692-0003 Site: Electrical Equipment Room - Light Grey Paint	10/26/2020	10/28/2020	0.0214 g	0.093 % wt	<0.093 % wt
191-LP4 342015692-0004 Site: Electrical Equipment Room - Dark Grey Paint	10/26/2020	10/28/2020	0.0600 g	0.033 % wt	<0.033 % wt
191-LP5 342015692-0005 Site: Electrical Equipment Room - Beige Garage Door Paint	10/26/2020	10/28/2020	0.1147 g	0.017 % wt	0.22 % wt
191-LP6 342015692-0006 Site: Blower Bay - Pipe Coating	10/26/2020	10/28/2020	0.0855 g	0.023 % wt	<0.023 % wt
191-LP7 342015692-0007 Site: Blower Bay - Beige Door Frame Paint	10/26/2020	10/28/2020	0.3126 g	0.0080 % wt	<0.0080 % wt
191-LP8 342015692-0008 Site: Blower Bay - Generator Paint	10/26/2020	10/28/2020	0.0618 g	0.032 % wt	<0.032 % wt
191-LP9 342015692-0009 Site: Blower Bay - Tan Door Frame Paint	10/26/2020	10/28/2020	0.0729 g	0.027 % wt	<0.027 % wt
191-LP10 342015692-0010 Site: Blower Bay - Green Pipe/Crane Paint	10/26/2020	10/28/2020	0.0957 g	0.021 % wt	<0.021 % wt
191-LP11 342015692-0011 Site: Blower Bay - Yellow Pipe Paint	10/26/2020	10/28/2020	0.0340 g	0.059 % wt	<0.059 % wt


 Carlos Rivadeneyra, Laboratory Director
 or other approved signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted.
 Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008% wt based on the minimum sample weight per our SOP. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.
 Samples analyzed by EMSL Analytical, Inc. Orlando, FL AIHA-LAP, LLC--ELLAP Accredited #163563

Initial report from 10/28/2020 19:52:23





EMSL Analytical, Inc.
 3303 PARKWAY CENTER COURT, Orlando, FL 32808
 Phone/Fax (407) 599-5887 / (407) 599-9063
<http://www.EMSL.com> orlandolab@emsl.com

EMSL Order: 342015692
 CustomerID: OCCU56
 CustomerPO:
 ProjectID:

Attn: **Tom Martinelli** Phone: (813) 626-8156
OHC Environmental Engineering, Inc. Fax: (813) 623-6702
101 South Hoover Blvd Received: 10/27/2020 10:05 AM
Suite 101 Collected: 10/26/2020
Tampa, FL 33609
 Project: 200191-AL Clearwater NE WWTP

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

<i>Client Sample Description</i>	<i>Collected</i>	<i>Analyzed</i>	<i>Weight</i>	<i>RDL</i>	<i>Lead Concentration</i>
191-LP12 342015692-0012	10/26/2020	10/28/2020	0.0789 g	0.025 % wt	<0.025 % wt
	Site: Blower Bay - Orange Paint On				
191-LP13 342015692-0013	10/26/2020	10/28/2020	0.1337 g	0.015 % wt	<0.015 % wt
	Site: Blower Bay - Brown Door Paint				
191-LP14 342015692-0014	10/26/2020	10/28/2020	0.0650 g	0.031 % wt	<0.031 % wt
	Site: Blower Bay - Black Garage Door Frame Paint				
191-LP15 342015692-0015	10/26/2020	10/28/2020	0.1127 g	0.018 % wt	0.059 % wt
	Site: Electrical Equip Room - Locker Paint				

Data reported may not reach applicable analytical sensitivity due to insufficient sample weights submitted. Suggested weight for analysis is 0.25 g.

Carlos Rivadeneyra, Laboratory Director
 or other approved signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted.
 Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008% wt based on the minimum sample weight per our SOP. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.
 Samples analyzed by EMSL Analytical, Inc. Orlando, FL AIHA-LAP, LLC--ELLAP Accredited #163563

Initial report from 10/28/2020 19:52:23



OrderID: 342015692



Lead (Pb) Chain of Custody
 EMSL Order ID (Lab Use Only):

342015692

EMSL ANALYTICAL, INC.
 200 ROUTE 130 NORTH
 CINNAMINSON, NJ 08077
 PHONE: (800) 220-3675
 FAX: (856) 786-5974

Company: OHC Environmental		EMSL-Bill to: <input checked="" type="checkbox"/> Same <input type="checkbox"/> Different If Bill to is Different note instructions in Comments**	
Street: 101 S. Hoover Blvd Suite 101		Third Party Billing requires written authorization from third party	
City: Tampa	State/Province: FL	Zip/Postal Code: 33609	Country: —
Report To (Name): Tom Martinelli		Telephone #: 813 401 0724	
Email Address: tmartinelli@ohcnet.com		Fax #: —	Purchase Order: —
Project Name/Number: 200191-AL Clearwater		Please Provide Results: <input type="checkbox"/> Fax <input checked="" type="checkbox"/> Email	
U.S. State Samples Taken: FL NE WWTP		CT Samples: <input type="checkbox"/> Commercial/Taxable <input type="checkbox"/> Residential/Tax Exempt	
Turnaround Time (TAT) Options* - Please Check			
<input type="checkbox"/> 3 Hour <input type="checkbox"/> 6 Hour <input type="checkbox"/> 24 Hour <input checked="" type="checkbox"/> 48 Hour <input type="checkbox"/> 72 Hour <input type="checkbox"/> 96 Hour <input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Week			
<small>*Analysis completed in accordance with EMSL's Terms and Conditions located in the Price Guide</small>			
Matrix	Method	Instrument	Reporting Limit
Chips <input checked="" type="checkbox"/> % by wt. <input type="checkbox"/> mg/cm ² <input type="checkbox"/> ppm	SW846-7000B	Flame Atomic Absorption	0.01%
Air	NIOSH 7082	Flame Atomic Absorption	4 µg/filter
	NIOSH 7105	Graphite Furnace AA	0.03 µg/filter
	NIOSH 7300 modified	ICP-AES/ICP-MS	0.5 µg/filter
Wipe* <small>ASTM <input type="checkbox"/> non ASTM <input type="checkbox"/> *if no box is checked, non-ASTM Wipe is assumed</small>	SW846-7000B	Flame Atomic Absorption	10 µg/wipe
	SW846-6010B or C	ICP-AES	1.0 µg/wipe
	SW846-7000B/7010	Graphite Furnace AA	0.075 µg/wipe
TCLP	SW846-1311/7000B/SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)
	SW846-1131/SW846-6010B or C	ICP-AES	0.1 mg/L (ppm)
Soil	SW846-7000B	Flame Atomic Absorption	40 mg/kg (ppm)
	SW846-7010	Graphite Furnace AA	0.3 mg/kg (ppm)
	SW846-6010B or C	ICP-AES	2 mg/kg (ppm)
Wastewater Unpreserved <input type="checkbox"/> Preserved with HNO ₃ pH < 2 <input type="checkbox"/>	SM3111B/SW846-7000B	Flame Atomic Absorption	0.4 mg/L (ppm)
	EPA 200.9	Graphite Furnace AA	0.003 mg/L (ppm)
	EPA 200.7	ICP-AES	0.020 mg/L (ppm)
Drinking Water Unpreserved <input type="checkbox"/> Preserved with HNO ₃ pH < 2 <input type="checkbox"/>	EPA 200.9	Graphite Furnace AA	0.003 mg/L (ppm)
	EPA 200.8	ICP-MS	0.001 mg/L (ppm)
TSP/SPM Filter	40 CFR Part 50	ICP-AES	12 µg/filter
	40 CFR Part 50	Graphite Furnace AA	3.6 µg/filter
Other: <input type="checkbox"/>			
Name of Sampler: Tom Martinelli		Signature of Sampler: <i>Tom Martinelli</i>	
Sample #	Location	Volume/Area	Date/Time Sampled
191-LP1	ELECTRICAL EQUIPMENT ROOM - TAN WALL PAINT		10-26-20
191-LP2	ELECTRICAL EQUIPMENT ROOM - BROWN FLOOR PAINT		
191-LP3	ELECTRICAL EQUIPMENT ROOM - LIGHT GREY PAINT		
191-LP4	ELECTRICAL EQUIPMENT ROOM - DARK GREY PAINT		
191-LP5	ELECTRICAL EQUIPMENT ROOM - BEIGE GARAGE DOOR PAINT		
Client Sample #'s	LP1 - LP-15	Total # of Samples:	15
Relinquished (Client): <i>Tom Martinelli</i>	Date: 10-26-20	Time:	
Received (Lab): <i>[Signature]</i>	Date: OCT 27 2020	Time: 10:05	
Comments:			

Sampled Document - Lead (Pb) 0004-RS-3-2014



OrderID: 342015692



EMSL ANALYTICAL, INC.
 LABORATORY PRODUCTS TRAINING

LEAD (Pb) CHAIN OF CUSTODY

EMSL ORDER ID (Lab Use Only):

342015692

EMSL ANALYTICAL, INC.
 200 ROUTE 130 NORTH
 CINNAMINSON, NJ 08077
 PHONE: (800) 220-3675
 FAX: (856) 786-5974

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information


Sample #	Location	Volume/Area	Date/Time Sampled
191-LP6	BLOWER BAY - PIPE COATING		
191-LP7	BLOWER BAY - BEIGE DOOR FRAME PAINT		
191-LP8	BLOWER BAY - GENERATOR PAINT		
191-LP9	BLOWER BAY - TAN DOOR FRAME PAINT		
191-LP10	BLOWER BAY - GREEN PIPE/CRANE PAINT		
191-LP11	BLOWER BAY - YELLOW PIPE PAINT		
191-LP12	BLOWER BAY - ORANGE PAINT ON		
191-LP13	BLOWER BAY - BROWN DOOR PAINT		
191-LP14	BLOWER BAY - BLACK GARAGE DOOR FRAME PAINT		
191-LP15	ELECTRICAL EQUIP ROOM - LOCKER PAINT		
Comments/Special Instructions:			

Controlled Document - Lead/Pb/COC - RS - 01/2012




APPENDIX F

**CONSULTANT & LABORATORY
CREDENTIALS**

 Ron DeSantis, Governor

Halsey Beshears, Secretary



STATE OF FLORIDA
DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

ASBESTOS LICENSING UNIT

THE ASBESTOS BUSINESS ORGANIZATION HEREIN IS LICENSED UNDER THE
PROVISIONS OF CHAPTER 469, FLORIDA STATUTES

OHC ENVIRONMENTAL ENGINEERING, INC.

101 S. HOOVER BLVD
SUITE 101
TAMPA FL 33609

LICENSE NUMBER: ZA0000060

EXPIRATION DATE: NOVEMBER 30, 2021

Always verify licenses online at MyFloridaLicense.com



Do not alter this document in any form.

This is your license. It is unlawful for anyone other than the licensee to use this document.



american board of industrial hygiene®

organized to improve the practice of industrial hygiene
proclaims that

Jim F. Rizk

having met all requirements of
education, experience and examination, and
ongoing maintenance,
is hereby certified in the

**COMPREHENSIVE PRACTICE
of
INDUSTRIAL HYGIENE**

and has the right to use the designations

CERTIFIED INDUSTRIAL HYGIENIST

CIH

Certificate Number **3956 CP**
Awarded: **June 30, 1988**
Expiration Date: **December 1, 2020**





Nicole Green

Chair, ABIH

[Signature]

Chief Executive Officer, ABIH

 Ron DeSantis, Governor

Halsey Beshears, Secretary 


STATE OF FLORIDA
DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION
ASBESTOS LICENSING UNIT

THE ASBESTOS CONSULTANT HEREIN IS LICENSED UNDER THE
PROVISIONS OF CHAPTER 469, FLORIDA STATUTES

RIZK, JAMES FAHMY
101 SOUTH HOOVER BLVD
SUITE 101
TAMPA FL 33609

LICENSE NUMBER: 1A0000022
EXPIRATION DATE: NOVEMBER 30, 2020

Always verify licenses online at MyFloridaLicense.com



Do not alter this document in any form.

This is your license. It is unlawful for anyone other than the licensee to use this document.



CHC Training
Nationwide Training & Certification Experts

www.chctraining.com
303.412.6360
855.60.CERTIFY

1775 West 55th Avenue
Denver, CO 80221,
United States of America

CERTIFICATE OF ACHIEVEMENT

This certificate is awarded to:

TOM MARTINELLI

101 South Hoover Blvd Suite 101 Tampa, FL 33609

In recognition of satisfactory completion of the EPA-approved annual asbestos refresher (synchronous online) training course under section 206 of the Toxic Substance Control Act (TSCA), Title II entitled:

BUILDING INSPECTOR

COURSE COMPLETION DATE:	APRIL 16, 2020
EXAMINATION DATE:	APRIL 16, 2020
EXPIRATION DATE:	APRIL 16, 2021
COURSE HOURS:	4.0



Verify this Credential

Danaya N. Benedetto
CEO & Training Program Manager

Credential License ID:
16475299

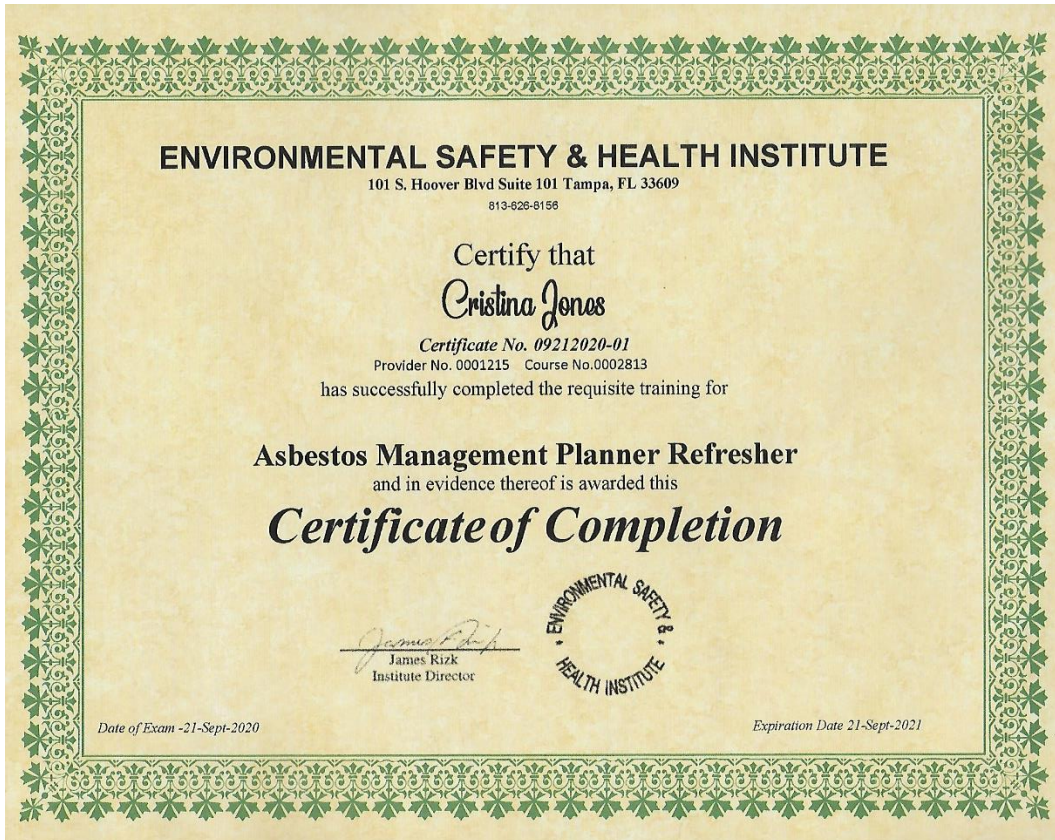


Aaron Flax
Instructor

CHC Training Certificate No.
R20-0233-AI-O-AL



Visit our Website



United States Department of Commerce
National Institute of Standards and Technology



Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 101151-0

EMSL Analytical, Inc.
Orlando, FL


*is accredited by the National Voluntary Laboratory Accreditation Program for specific services,
listed on the Scope of Accreditation, for:*

Asbestos Fiber Analysis

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality
management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).*

2020-07-01 through 2021-06-30
Effective Dates




For the National Voluntary Laboratory Accreditation Program

United States Department of Commerce
National Institute of Standards and Technology



Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 600215-0

EMSL Analytical, Inc. - Tampa, FL
Tampa, FL

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services,
listed on the Scope of Accreditation, for:*

Asbestos Fiber Analysis

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality
management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).*

2020-10-01 through 2021-09-30
Effective Dates



For the National Voluntary Laboratory Accreditation Program



----- END OF REPORT -----

SECTION V

CONTRACT DOCUMENTS

Table of Contents

PUBLIC CONSTRUCTION BOND	1
CONTRACT.....	4
CONSENT OF SURETY TO FINAL PAYMENT	8
PROPOSAL/BID BOND.....	9
AFFIDAVIT	10
NON-COLLUSION AFFIDAVIT	11
PROPOSAL.....	12
CITY OF CLEARWATER ADDENDUM SHEET	14
BIDDER’S PROPOSAL.....	15
SCRUTINIZED COMPANIES AND BUSINESS OPERATIONS WITH CUBA AND SYRIA CERTIFICATION FORM.....	17
SCRUTINIZED COMPANIES THAT BOYCOTT ISRAEL LIST CERTIFICATION FORM.....	18

Bond No.: _____

PUBLIC CONSTRUCTION BOND

(1)

This bond is given to comply with § 255.05, Florida Statutes, and any action instituted by a claimant under this bond for payment must be in accordance with the notice and time limitation provisions in subsections (2) and (10).

Pursuant to § 255.05(1)(b), Florida Statutes, “**Before commencing the work** or before recommencing the work after a default or abandonment, **the contractor shall provide to the public entity a certified copy of the recorded bond**. Notwithstanding the terms of the contract or any other law governing prompt payment for construction services, the public entity may not make a payment to the contractor until the contractor has complied with this paragraph.”

CONTRACTOR**SURETY****OWNER**_____
[name]_____
[name]

City of Clearwater
Public Utilities
100 S. Myrtle Avenue
Clearwater, FL 33756
(727) 562-4750

[principal business address]_____
[principal business address]_____
[phone number]_____
[phone number]**PROJECT NAME:** NE WRF MCC-1, DC1 & 2 Replacement**PROJECT NO.:** 17-0028-UT**PROJECT DESCRIPTION:** The major work can be described as follows:

The creation of a separate Electrical Room within the existing Control Building electrical area. Electrical Room to be air conditioned with a raised “data center” floor capable of supporting the electrical equipment. Room to have mezzanine floor with staircase and double doors.

New access door to Blower Room from Control Building electrical area and modifications to existing concrete floor to address subsidence.

The replacement and relocation of the 2nd Anoxic Mixer motor control center (MCC-1) and the switchgear distribution centers (DC-1 and DC-2) to be installed in new electrical room. Removal of existing FRP structure with existing MCC-1

Project includes a new 1200A Nema 4X Service Entrance Breaker with new Utility transformer connection; new Automatic Transfer Switch, NEMA 12 switchboards, “Smart” MCC, Integral Power Center, panelboards, and Trystar generator load bank tap box, all associated concrete ductbanks, handholes, and cable trays. Project also includes incorporation of “Smart” MCC into existing SCADA system which will require programming services.

Existing ATS shall be offered to City for salvage.

As part of structural portion of the project a concrete block wall and footer will be replaced due to failure with a new grade beam foundation and CMU block. Equipment attached to the wall will need to be detached, temporarily supported and re-attached. Replacement of some of the equipment as noted is a part of this effort.

Blower Room plenum area to be filled in and intake structure removed. Refer to drawings.

Contractor responsible for maintenance of plant operations, provide any or all temporary power or controls connections, which may include temporary primary generation and standby power equipment.

BY THIS BOND, We, _____, as Contractor, and _____, a corporation, as Surety, are bound to the City of Clearwater, Florida, herein called Owner, in the sum of \$[x,xxx,xxx.xx], for payment of which we bind ourselves, our heirs, personal representatives, successors, and assigns, jointly and severally.

THE CONDITION OF THIS BOND is that if Contractor:

1. Performs the contract dated _____, between Contractor and Owner for construction of NE WRF MCC-1, DC1 & 2 Replacement the contract documents being made a part of this bond by reference (which include the Advertisement for Bids, Proposal, Contract, Surety Bond, Instructions to Bidders, General Conditions, Plans, Technical Specifications and Appendix, and such alterations as may be made in said Plans and Specifications as therein provided for), at the times and in the manner prescribed in the contract; and
2. Promptly makes payments to all claimants, as defined in Section 255.05(1), Florida Statutes, supplying Contractor with labor, materials, or supplies, used directly or indirectly by Contractor in the prosecution of the work provided for in the contract; and

Bond No.: _____

PUBLIC CONSTRUCTION BOND

(2)

- 3. Pays Owner all losses, damages, expenses, costs, and attorney’s fees, including appellate proceedings, that Owner sustains because of a default by Contractor under the contract; and
- 4. To the limits of § 725.06(2), Florida Statutes, shall indemnify and hold harmless Owner, their officers and employees, from liabilities, damages, losses and costs, including, but not limited to, reasonable attorney’s fees, to the extent caused by the negligence, recklessness, or intentional wrongful misconduct of Contractor and persons employed or utilized by Contractor in the performance of the construction contract; and
- 5. Performs the guarantee of all work and materials furnished under the contract for the time specified in the contract, then this bond is void; otherwise, it remains in full force.
- 6. Any action instituted by a claimant under this bond for payment must be in accordance with the notice and time limitation provisions in Section 255.05(2), Florida Statutes.
- 7. Any changes in or under the contract documents and compliance or noncompliance with any formalities connected with the contract or the changes does not affect Surety’s obligation under this bond, and Surety does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the work or to the specifications.

IN TESTIMONY WHEREOF, witness the hands and seals of the parties hereto this _____ day of _____, 20__.

*(If sole Ownership or Partnership, two (2) Witnesses required).
(If Corporation, Secretary only will attest and affix seal).*

[TYPE LEGAL NAME OF CONTRACTOR]

By: _____
Title: _____
Print Name: _____

WITNESS:

WITNESS:

Corporate Secretary or Witness
Print Name: _____

Print Name: _____

(affix corporate seal)

(Corporate Surety)

By: _____
ATTORNEY-IN-FACT
Print Name: _____

(affix corporate seal)

(Power of Attorney must be attached)

CONTRACT

(1)

This **CONTRACT** made and entered into this ___ day of _____, 20__ by and between the City of Clearwater, Florida, a municipal corporation, hereinafter designated as the "City", and _____, of the City of _____ County of _____ and State of Florida, hereinafter designated as the "Contractor".

[Or, if out of state:]

This **CONTRACT** made and entered into this ___ day of _____, 20__ by and between the City of Clearwater, Florida, a municipal corporation, hereinafter designated as the "City", and _____, a/an _____ (State) Corporation authorized to do business in the State of Florida, of the City of _____ County of _____ and State of _____, hereinafter designated as the "Contractor".

WITNESSETH:

That the parties to this contract each in consideration of the undertakings, promises and agreements on the part of the other herein contained, do hereby undertake, promise and agree as follows:

The Contractor, and his or its successors, assigns, executors or administrators, in consideration of the sums of money as herein after set forth to be paid by the City and to the Contractor, shall and will at **their** own cost and expense perform all labor, furnish all materials, tools and equipment for the following:

PROJECT NAME: NE WRF MCC-1, DC1 & 2 REPLACEMENT

PROJECT NO.: 17-0028-UT

in the amount of \$ _____

In accordance with such proposal and technical supplemental specifications and such other special provisions and drawings, if any, which will be submitted by the City, together with any advertisement, instructions to bidders, general conditions, technical specifications, proposal and bond, which may be hereto attached, and any drawings if any, which may be herein referred to, are hereby made a part of this contract, and all of said work to be performed and completed by the contractor and its successors and assigns shall be fully completed in a good and workmanlike manner to the satisfaction of the City.

If the Contractor should fail to comply with any of the terms, conditions, provisions or stipulations as contained herein within the time specified for completion of the work to be performed by the Contractor, then the City, may at its option, avail itself of any or all remedies provided on its behalf and shall have the right to proceed to complete such work as Contractor is obligated to perform in accordance with the provisions as contained herein.

CONTRACT

(2)

THE CONTRACTOR AND HIS OR ITS SUCCESSORS AND ASSIGNS DOES HEREBY AGREE TO ASSUME THE DEFENSE OF ANY LEGAL ACTION WHICH MAY BE BROUGHT AGAINST THE CITY AS A RESULT OF THE CONTRACTOR'S ACTIVITIES ARISING OUT OF THIS CONTRACT AND FURTHERMORE, IN CONSIDERATION OF THE TERMS, STIPULATIONS AND CONDITIONS AS CONTAINED HEREIN, AGREES TO HOLD THE CITY FREE AND HARMLESS FROM ANY AND ALL CLAIMS FOR DAMAGES, COSTS OF SUITS, JUDGMENTS OR DECREES RESULTING FROM ANY CLAIMS MADE UNDER THIS CONTRACT AGAINST THE CITY OR THE CONTRACTOR OR THE CONTRACTOR'S SUB CONTRACTORS, AGENTS, SERVANTS OR EMPLOYEES RESULTING FROM ACTIVITIES BY THE AFOREMENTIONED CONTRACTOR, SUB CONTRACTOR, AGENT SERVANTS OR EMPLOYEES, TO THE LIMITS OF § 725.06(2).

In addition to the foregoing provisions, the Contractor agrees to conform to the following requirements:

In connection with the performance of work under this contract, the Contractor agrees not to discriminate against any employee or applicant for employment because of race, sex, religion, color, or national origin. The aforesaid provision shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; lay off or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post hereafter in conspicuous places, available for employees or applicants for employment, notices to be provided by the contracting officer setting forth the provisions of the non-discrimination clause.

The Contractor further agrees to insert the foregoing provisions in all contracts hereunder, including contracts or agreements with labor unions and/or worker's representatives, except sub-contractors for standard commercial supplies or raw materials.

It is mutually agreed between the parties hereto that time is of the essence of this contract, and in the event that the work to be performed by the Contractor is not completed within the time stipulated herein, it is then further agreed that the City may deduct from such sums or compensation as may be due to the Contractor the sum of **\$1,000.00 per day** for each day that the work to be performed by the Contractor remains incomplete beyond the time limit specified herein, which sum of **\$1,000.00 per day** shall only and solely represent damages which the City has sustained by reason of the failure of the Contractor to complete the work within the time stipulated, it being further agreed that this sum is not to be construed as a penalty but is only to be construed as liquidated damages for failure of the Contractor to complete and perform all work within the time period as specified in this contract.

It is further mutually agreed between the City and the Contractor that if, any time after the execution of this contract and the public construction bond which is attached hereto for the faithful performance of the terms and conditions as contained herein by the Contractor, that the City shall at any time deem the surety or sureties upon such public construction bond to be unsatisfactory or if, for any reason, the said bond ceases to be adequate in amount to cover the performance of the work the Contractor shall, at his or its own expense, within ten (10) days after receipt of written notice from the City to do so, furnish an additional bond or bonds in such term and amounts and with such surety or sureties as shall be satisfactory to the City. If such an event occurs, no further payment shall be made to the Contractor under the terms and provisions of this contract until such new or additional security bond guaranteeing the faithful performance of the work under the terms hereof shall be completed and furnished to the City in a form satisfactory to it.

CONTRACT

(3)

In addition to all other contract requirements as provided by law, the contractor executing this agreement agrees to comply with public records law.

IF THE CONTRACTOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, THE CONTRACTORS DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS CONTRACT. CONTACT THE CUSTODIAN OF PUBLIC RECORDS, Rosemarie Call, City Clerk, AT Rosemarie.Call@myclearwater.com, 727-562-4092, 600 Cleveland St. Clearwater, FL 33756.

The contractor's agreement to comply with public records law applies specifically to:

- a) Keep and maintain public records required by the City of Clearwater (hereinafter “public agency”) to perform the service being provided by the contractor hereunder.
- b) Upon request from the public agency’s custodian of public records, provide the public agency with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a cost that does not exceed the cost provided for in Chapter 119, Florida Statutes, as may be amended from time to time, or as otherwise provided by law.
- c) Ensure that the public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law for the duration of the contract term and following completion of the contract if the contractor does not transfer the records to the public agency.
- d) Upon completion of the contract, transfer, at no cost, to the public agency all public records in possession of the contractor or keep and maintain public records required by the public agency to perform the service. If the contractor transfers all public records to the public agency upon completion of the contract, the contractor shall destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. If the contractor keeps and maintains public records upon completion of the contract, the contractor shall meet all applicable requirements for retaining public records. All records stored electronically must be provided to the public agency, upon request from the public agency’s custodian of public records, in a format that is compatible with the information technology systems of the public agency.
- e) A request to inspect or copy public records relating to a public agency’s contract for services must be made directly to the public agency. If the public agency does not possess the requested records, the public agency shall immediately notify the contractor of the request and the contractor must provide the records to the public agency or allow the records to be inspected or copied within a reasonable time.
- f) The contractor hereby acknowledges and agrees that if the contractor does not comply with the public agency’s request for records, the public agency shall enforce the contract provisions in accordance with the contract.
- g) A contractor who fails to provide the public records to the public agency within a reasonable time may be subject to penalties under Section 119.10, Florida Statutes.
- h) If a civil action is filed against a contractor to compel production of public records relating to a public agency’s contract for services, the court shall assess and award against the contractor the reasonable costs of enforcement, including reasonable attorney fees, if:
 1. The court determines that the contractor unlawfully refused to comply with the public records request within a reasonable time; and

CONTRACT

(4)

- 2. **At least 8 business days before filing the action, the plaintiff provided written notice of the public records request, including a statement that the contractor has not complied with the request, to the public agency and to the contractor.**
 - i) **A notice complies with subparagraph (h)2. if it is sent to the public agency’s custodian of public records and to the contractor at the contractor’s address listed on its contract with the public agency or to the contractor’s registered agent. Such notices must be sent by common carrier delivery service or by registered, Global Express Guaranteed, or certified mail, with postage or shipping paid by the sender and with evidence of delivery, which may be in an electronic format.**
 - j) **A contractor who complies with a public records request within 8 business days after the notice is sent is not liable for the reasonable costs of enforcement.**

IN WITNESS WHEREOF, the parties to the agreement have hereunto set their hands and seals and have executed this Agreement, the day and year first above written.

**CITY OF CLEARWATER
IN PINELLAS COUNTY, FLORIDA**

By: _____
Jennifer Poirrier
City Manager

(SEAL)

Attest:

Countersigned:

Rosemarie Call
City Clerk

By: _____
Brian Aungst, Sr.
Mayor

Approved as to form:

Owen Kohler
Assistant City Attorney

Contractor must indicate whether:

_____ Corporation, _____ Partnership, _____ Company, or _____ Individual

(Contractor)

By: _____ (SEAL)
Print Name: _____
Title: _____

The person signing shall, in his own handwriting, sign the Principal's name, his own name, and his title; where the person is signing for a Corporation, he must, by Affidavit, show his authority to bind the Corporation – **provide Affidavit.**

CONSENT OF SURETY TO FINAL PAYMENT

TO OWNER: City of Clearwater PROJECT NAME: NE WRF MCC-1, DC1 & 2
 REPLACEMENT

Public Utilities PROJECT NO.: 17-0028-UT

100 S. Myrtle Ave. CONTRACT DATE: [REDACTED]

Clearwater, FL 33756 BOND NO.: [REDACTED], recorded in O.R. Book [REDACTED],
 Page [REDACTED], of the Public Records of Pinellas County, Florida.

CONTRACTOR: [REDACTED]

Pursuant to § 255.05(11), Florida Statutes, and in accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the:

[insert name of Surety]
 [address]
 [address] ,SURETY,

on bond of

[insert name of Contractor]
 [address]
 [address] ,CONTRACTOR,

hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve Surety of any of its obligations to

City of Clearwater
 Public Utilities
 100 S. Myrtle Ave.
 Clearwater, FL 33756 ,OWNER,

as set forth in said Surety’s bond.

IN WITNESS WHEREOF, the Surety has hereunto set its hand this ___ day of _____, _____

(Surety)

(Signature of authorized representative)

(Printed name and title)

Attest:
(Seal):

PROPOSAL/BID BOND

(Not to be filled out if a certified check is submitted)

KNOWN ALL MEN BY THESE PRESENTS: That we, the undersigned, _____
_____ as Contractor, and _____
_____ as Surety, whose address is _____,
_____ are held and firmly bound unto the City
of Clearwater, Florida, in the sum of _____ Dollars
(\$ _____) (being a minimum of 10% of Contractor's total bid amount) for the payment of which,
well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors,
administrators, successors and assigns.

The condition of the above obligation is such that if the attached Proposal of _____
_____ as Contractor, and _____ as Surety, for
work specified as: _____

all as stipulated in said Proposal, by doing all work incidental thereto, in accordance with the plans and
specifications provided herefor, all within Pinellas County, is accepted and the contract awarded to the
above named bidder, and the said bidder shall within ten days after notice of said award enter into a contract,
in writing, and furnish the required Public Construction Bond with surety or sureties to be approved by the
City Manager, this obligation shall be void, otherwise the same shall be in full force and virtue by law and
the full amount of this Proposal/Bid Bond will be paid to the City as stipulated or liquidated damages.

Principal must indicate whether:
_____ Corporation, _____ Partnership, _____ Company, or _____ Individual

Signed this _____ day of _____, 20____.

Contractor

Principal

By: _____
Title

Surety

The person signing shall, in his own handwriting, sign the Principal's name, his own name, and his title;
where the person is signing for a Corporation, he must, by Affidavit, show his authority to bind the
Corporation – **provide Affidavit.**

AFFIDAVIT

(To be filled in and executed if the bidder is a corporation)

STATE OF FLORIDA)

COUNTY OF _____)

_____, being duly sworn, deposes and says that he/she is Secretary of _____ a corporation organized and existing under and by virtue of the laws of the State of Florida, and having its principal office at:

(Street & Number) (City) (County) (State)

Affiant further says that he is familiar with the records, minute books and by-laws of

(Name of Corporation)

Affiant further says that _____ is _____
(Officer's Name) (Title)

of the corporation, is duly authorized to sign the Proposal for _____

or said corporation by virtue of _____
(state whether a provision of by laws or a Resolution of Board of Directors. If by Resolution give date of adoption).

Affiant

Sworn to before me this _____ day of _____, 20____.

Notary Public

Type/print/stamp name of Notary

Title or rank, and Serial No., if any

NON-COLLUSION AFFIDAVIT

STATE OF FLORIDA)

COUNTY OF _____)

_____ being, first duly sworn, deposes and says that he is

_____ of _____,
the party making the foregoing Proposal or Bid; that such Bid is genuine and not collusive or sham: that said bidder is not financially interested in or otherwise affiliated in a business way with any other bidder on the same contract; that said bidder has not colluded, conspired, connived, or agreed, directly or indirectly, with any bidders or person, to put in a sham bid or that such other person shall refrain from bidding, and has not in any manner, directly or indirectly, sought by agreement or collusion, or communication or conference, with any person, to fix the bid price or affiant or any other bidder, or to fix any overhead, profit or cost element of said bid price, or that of any other bidder, or to secure any advantage against the City of Clearwater, Florida, or any person or persons interested in the proposed contract; and that all statements contained in said proposal or bid are true; and further, that such bidder has not directly or indirectly submitted this bid, or the contents thereof, or divulged information or data relative thereto to any association or to any member or agent thereof.

Affiant

Sworn to and subscribed before me this _____ day of _____, 20_____.

Notary Public

PROPOSAL

(1)

TO THE CITY OF CLEARWATER, FLORIDA, for

NE WRF MCC-1, DC1 & 2 REPLACEMENT-17-0028-UT

and doing such other work incidental thereto, all in accordance with the contract documents, marked

NE WRF MCC-1, DC1 & 2 REPLACEMENT-17-0028-UT

Every bidder must take notice of the fact that even though his proposal be accepted and the documents signed by the bidder to whom an award is made and by those officials authorized to do so on behalf of the City of Clearwater, Florida, that no such award or signing shall be considered a binding contract without a certificate from the Finance Director that funds are available to cover the cost of the work to be done, or without the approval of the City Attorney as to the form and legality of the contract and all the pertinent documents relating thereto having been approved by said City Attorney; and such bidder is hereby charged with this notice.

The signer of the Proposal, as bidder, also declares that the only person, persons, company or parties interested in this Proposal, are named in this Proposal, that he has carefully examined the Advertisement, Instructions to Bidders, Contract Specifications, Plans, Supplemental Specifications, General Conditions, Special Provisions, and Public Construction Bond, that he or his representative has made such investigation as is necessary to determine the character and extent of the work and he proposes and agrees that if the Proposal be accepted, he will contract with the City of Clearwater, Florida, in the form of contract; hereto annexed, to provide the necessary labor, materials, machinery, equipment, tools or apparatus, do all the work required to complete the contract within the time mentioned in the General Conditions and according to the requirements of the City of Clearwater, Florida, as herein and hereinafter set forth, and furnish the required surety bonds for the following prices to wit:

If the foregoing Proposal shall be accepted by the City of Clearwater, Florida, and the undersigned shall fail to execute a satisfactory contract as stated in the Advertisement herein attached, then the City may, at its option determine that the undersigned has abandoned the contract, and thereupon this Proposal shall be null and void, and the certified check or bond accompanying this Proposal, shall be forfeited to become the property of the City of Clearwater, Florida, and the full amount of said check shall be retained by the City, or if the Proposal Bond be given, the full amount of such bond shall be paid to the City as stipulated or liquidated damages; otherwise, the bond or certified check accompanying this Proposal, or the amount of said check, shall be returned to the undersigned as specified herein.

PROPOSAL

(2)

Attached hereto is a bond or certified check on _____
_____ Bank, for the sum of _____
_____ (\$_____)
(being a minimum of 10% of Contractor's total bid amount).

The full names and residences of all persons and parties interested in the foregoing bid are as follows:

(If corporation, give the names and addresses of the President and Secretary. If firm or partnership, the names and addresses of the members or partners. The Bidder shall list not only his name but also the name of any person with whom bidder has any type of agreement whereby such person's improvements, enrichment, employment or possible benefit, whether sub-contractor, materialman, agent, supplier, or employer is contingent upon the award of the contract to the bidder).

NAMES:

ADDRESSES:

_____	_____
_____	_____
_____	_____
_____	_____

Signature of Bidder: _____

The person signing shall, in his own handwriting, sign the Principal's name, his own name and his title. Where the person signing for a corporation is other than the President or Vice President, he must, by affidavit, show his authority, to bind the corporation.

Principal: _____

By: _____ Title: _____

Company Legal Name: _____

Doing Business As (if different than above): _____

Business Address of Bidder: _____

City and State: _____ Zip Code _____

Phone: _____ Email Address: _____

Dated at _____, this _____ day of _____, A.D., 20__.

CITY OF CLEARWATER
ADDENDUM SHEET

PROJECT: NE WRF MCC-1, DC1 & 2 REPLACEMENT-17-0028-UT

Acknowledgment is hereby made of the following addenda received since issuance of Plans and Specifications.

Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____
Addendum No. _____	Date: _____

(Name of Bidder)

(Signature of Officer)

(Title of Officer)

(Date)

BIDDER'S PROPOSAL**PROJECT: NE WRF MCC-1, DC1 & 2 REPLACEMENT-17-0028-UT****CONTRACTOR:** _____**BIDDER'S GRAND TOTAL: \$** _____ **(Numbers)****BIDDER'S GRAND TOTAL:** __________ **(Words)**

	BID ITEMS	QT Y	UNI T	UNIT PRICE	AMOUNT
1	MOBILIZATION/DEMOLIZATOIN/GENERAL CONDITIONS	1	LS		\$ -
2 A	Demolition, Excavation and Backfill	1	LS		\$ -
2 B	Concrete and Beams	1	LS		\$ -
3 A	HVAC	1	LS		\$ -
3 B	Room Improvements	1	LS		\$ -
4 A	General Electrical Provisions	1	LS		\$ -
4 B	Panelboards	1	EA		\$ -
4 C	MCC & Service Entrance Main Breaker	1	EA		\$ -
4 D	Switchboards SWBD-1, SWBD-2, Integrated Power	1	EA		\$ -
4 E	ASCO Automatic Transfer Switch w/ Bypass	1	LS		\$ -
4F	Trystar Load Bank and Portable Generator Docking Station	1	LS		\$ -
					\$ -
5	Record Drawing Allowance	1	LS	\$ 5,000.00	\$ 5,000.00

6	Permit Allowance	1	LS	\$ 2,000.00	\$ 2,000.00
					\$ -
	SUBTOTAL				\$ 7,000.00
7	10% CONTINGENCY				\$ 700.00
	TOTAL CONTRACT				\$ 7,700.00

THE BIDDER'S GRAND TOTAL ABOVE IS HIS TOTAL BID BASED ON HIS UNIT PRICES AND LUMP SUM PRICES AND THE ESTIMATED QUANTITIES REQUIRED FOR EACH SECTION. THIS FIGURE IS FOR INFORMATION ONLY AT THE TIME OF OPENING BIDS. THE CITY WILL MAKE THE TABULATION FROM THE UNIT PRICES AND LUMP SUM PRICE BID. IF THERE IS AN ERROR IN THE TOTAL BY THE BIDDER, IT SHALL BE CHANGED AS ONLY THE UNIT PRICES AND LUMP SUM PRICE SHALL GOVERN.

THE CONTRACTOR SHALL PROVIDE COPIES OF A CURRENT CONTRACTOR LICENSE/REGISTRATION WITH THE STATE OF FLORIDA AND PINELLAS COUNTY IN THE BID RESPONSE.

**SCRUTINIZED COMPANIES AND BUSINESS OPERATIONS WITH
CUBA AND SYRIA CERTIFICATION FORM**

PER SECTION III, ITEM 25, IF YOUR BID IS \$1,000,000 OR MORE, THIS FORM MUST BE COMPLETED AND SUBMITTED WITH THE BID PROPOSAL. FAILURE TO SUBMIT THIS FORM AS REQUIRED, MAY DEEM YOUR SUBMITTAL NONRESPONSIVE.

The affiant, by virtue of the signature below, certifies that:

1. The vendor, company, individual, principal, subsidiary, affiliate, or owner is aware of the requirements of section 287.135, Florida Statutes, regarding companies on the Scrutinized Companies with Activities in Sudan List, the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List, or engaging in business operations in Cuba and Syria; and
2. The vendor, company, individual, principal, subsidiary, affiliate, or owner is eligible to participate in this solicitation and is not listed on either the Scrutinized Companies with Activities in Sudan List, the Scrutinized Companies with Activities in the Iran Petroleum Sector List, or engaged in business operations in Cuba and Syria; and
3. Business Operations means, for purposes specifically related to Cuba or Syria, engaging in commerce in any form in Cuba or Syria, including, but not limited to, acquiring, developing, maintaining, owning, selling, possessing, leasing or operating equipment, facilities, personnel, products, services, personal property, real property, military equipment, or any other apparatus of business or commerce; and
4. If awarded the Contract (or Agreement), the vendor, company, individual, principal, subsidiary, affiliate, or owner will immediately notify the City of Clearwater in writing, no later than five (5) calendar days after any of its principals are placed on the Scrutinized Companies with Activities in Sudan List, the Scrutinized Companies with Activities in the Iran Petroleum Sector List, or engages in business operations in Cuba and Syria.

Authorized Signature

Printed Name

Title

Name of Entity/Corporation

STATE OF _____

COUNTY OF _____

The foregoing instrument was acknowledged before me on this _____ day of _____, 20____, by _____ (name of person whose signature is being notarized) as the _____ (title) of _____ (name of corporation/entity), personally known to me as described herein _____, or produced a _____ (type of identification) as identification, and who did/did not take an oath.

Notary Public

Printed Name

My Commission Expires: _____

NOTARY SEAL ABOVE

SCRUTINIZED COMPANIES THAT BOYCOTT ISRAEL LIST
CERTIFICATION FORM

PER SECTION III, ITEM 25, THIS FORM MUST BE COMPLETED AND SUBMITTED WITH THE BID PROPOSAL. FAILURE TO SUBMIT THIS FORM AS REQUIRED, MAY DEEM YOUR SUBMITTAL NONRESPONSIVE.

The affiant, by virtue of the signature below, certifies that:

1. The vendor, company, individual, principal, subsidiary, affiliate, or owner is aware of the requirements of section 287.135, Florida Statutes, regarding companies on the Scrutinized Companies that Boycott Israel List, or engaged in a boycott of Israel; and
2. The vendor, company, individual, principal, subsidiary, affiliate, or owner is eligible to participate in this solicitation and is not listed on the Scrutinized Companies that Boycott Israel List, or engaged in a boycott of Israel; and
3. “Boycott Israel” or “boycott of Israel” means refusing to deal, terminating business activities, or taking other actions to limit commercial relations with Israel, or persons or entities doing business in Israel or in Israeli-controlled territories, in a discriminatory manner. A statement by a company that it is participating in a boycott of Israel, or that it has initiated a boycott in response to a request for a boycott of Israel or in compliance with, or in furtherance of, calls for a boycott of Israel, may be considered as evidence that a company is participating in a boycott of Israel; and
4. If awarded the Contract (or Agreement), the vendor, company, individual, principal, subsidiary, affiliate, or owner will immediately notify the City of Clearwater in writing, no later than five (5) calendar days after any of its principals are placed on the Scrutinized Companies that Boycott Israel List, or engaged in a boycott of Israel.

Authorized Signature

Printed Name

Title

Name of Entity/Corporation

STATE OF _____

COUNTY OF _____

The foregoing instrument was acknowledged before me on this _____ day of _____, 20____, by _____ (name of person whose signature is being notarized) as the _____ (title) of _____ (name of corporation/entity), personally known to me as described herein _____, or produced a _____ (type of identification) as identification, and who did/did not take an oath.

Notary Public

Printed Name

My Commission Expires: _____
NOTARY SEAL ABOVE