

CITY OF FRIENDSWOOD

PUBLIC WORKS DEPARTMENT



TM

PROJECT MANUAL FOR

Lift Station No. 2 Rehabilitation

March 2026



Kimley-Horn and Associates
Houston, TX 77079
281-597-9300

TABLE OF CONTENTS

CITY OF FRIENDSWOOD TECHNICAL SPECIFICATIONS

BOLD ITALICIZED – Item is bound within this specification manual.

Regular non-italicized – Item is not bound within this specification manual, however item is part of the contract. All items and specifications are available on the City of Friendswood’s website at “<https://www.ci.friendswood.tx.us>” and then:

- 1) Click on the “Government” button in the top bar
- 2) In the left side bar, click the link for “Departments”
- 3) In the left side bar, click the link for “Engineering”
- 3) In the left side bar, click the link for “Publications and Forms”
- 4) Scroll down to the links for the City of Friendswood’s Technical Specifications

DIVISION 00 – CONTRACTING DOCUMENTS

INTRODUCTORY INFORMATION

<i>Index to Technical Specifications</i>	00000
<i>Project Manual Cover</i>	00001
<i>Table of Contents</i>	00005
Sign In Sheet	00010

RFQ / RFP / ITB PROCESS

<i>Invitation to Propose (CSP)</i>	00100
<i>Instructions to Offerors (CSP)</i>	00101
Request For Proposal (RFP)	00105
Invitation to Bid (ITB)	00110
<i>Pre-Bid Meeting Outline</i>	00115
<i>Addendum</i>	00120
<i>Acknowledgement of Addenda</i>	00125
<i>Insurance Requirements</i>	00130
<i>Child Support Affidavit</i>	00135
<i>Bidder’s Bond</i>	00140
<i>Cost Proposal Form</i>	00145
<i>Total Stipulated Price Form</i>	00150
<i>Bid Tabulation Sheet</i>	00155
Post-Bid Procedures	00160

CONTRACTING REQUIREMENTS

Standard Agreement for Professional Services – Architect	00200
Standard Agreement for Professional Services – Engineer	00205

Standard Agreement for Professional Services – Testing	00210
Standard Agreement for Professional Services – Consulting	00215
Standard Agreement for Construction Manager at Risk (CMAR) Services	00220
Guaranteed Maximum Price Amendment	00225
Standard Agreement for Contracting Services	00230
Intent to Award	00235
Notice to Proceed	00240
Texas Workers Compensation	00245
Wage Scale	00250
Affidavit of Insurance	00255
Alcohol and Drug Free Workplace Policy	00260
Construction Storm Preparation Policy	00265
Hazardous Communications Program Requirement Agreement	00270
Homeland Security Policy	00275
Texas Ethics Commission Form 1295	00280
Texas Government Code Verification Form	
Performance Bond	00285
Payment Bond	00290
Vendor Information Packet	00295
General Conditions	00300
Supplementary Conditions	00305

PRECONSTRUCTION

Preconstruction Meeting Check List	00400
Preconstruction Meeting Outline (City Project)	00405
Preconstruction Meeting Outline (Developer)	00410

CONSTRUCTION

Time Extension Request	00500
Work Change Directive (WCD)	00505
Change Order (CO)	00510
Contractor Pay Application	00515
COF Payment Authorization	00520
Partial Waiver of Lien	00525
Final Waiver of Lien	00530
Non-Conformance Report (NCR)	00535
Stop Work Order	00540
Notice To Rescind Stop Work Order	00545
Final Walkthrough Checklist	00550

CLOSEOUT

Certificate of Substantial Completion	00600
Punch List	00605
Affidavit of Payment to Subcontractors and Suppliers	00610

<i>Contractor's Certification of Final Completion</i>	<i>00615</i>
<i>Notice of Final Completion</i>	<i>00620</i>
<i>One-Year Maintenance Bond.....</i>	<i>00625</i>
<i>Extended Warranty Maintenance Bond</i>	<i>00630</i>
<i>Certificate of One-Year Maintenance Acceptance</i>	<i>00635</i>
<i>Certificate of Extended Warranty Maintenance Bond Acceptance</i>	<i>00640</i>
<i>Release of Bond</i>	<i>00645</i>

DIVISION 01 – GENERAL REQUIREMENTS

<i>Submittal Procedures</i>	<i>01000</i>
<i>Minimum Conceptual Drawing Requirements.....</i>	<i>01005</i>
<i>Minimum Construction Drawing Requirements.....</i>	<i>01010</i>
<i>Measurement and Payment</i>	<i>01015</i>
<i>Contingencies and Allowances.....</i>	<i>01020</i>
<i>Change Order Procedures.....</i>	<i>01025</i>
<i>Work Restrictions.....</i>	<i>01030</i>
<i>Stabilized Construction Exit.....</i>	<i>01035</i>
<i>Control of Ground and Surface Water</i>	<i>01040</i>
<i>Storm Water Pollution Prevention Plan.....</i>	<i>01045</i>
<i>SWPPP Inspection Form.....</i>	<i>01050</i>
<i>TPDES Requirements.....</i>	<i>01055</i>
<i>Project Signage</i>	<i>01060</i>
<i>Utility Identification Markings.....</i>	<i>01065</i>
<i>Temporary Facilities and Control.....</i>	<i>01070</i>
<i>Traffic Control and Regulation.....</i>	<i>01075</i>
<i>Quality Control and Testing.....</i>	<i>01080</i>
<i>Diversion Pumping</i>	<i>01085</i>
<i>Utility Division Valve Assistance Procedures.....</i>	<i>01090</i>
<i>Utility Division Valve Assistance Form</i>	<i>01095</i>
<i>System Startups and O&M Manuals</i>	<i>01100</i>
<i>Tree and Plant Protection</i>	<i>01105</i>
<i>Reference Standards.....</i>	<i>01110</i>

DIVISION 02 – SITE WORK

EROSION CONTROL

<i>Erosion Control Systems.....</i>	<i>02000</i>
<i>Filter Fabric Silt Fence</i>	<i>02005</i>
<i>Straw Bale Fence.....</i>	<i>02010</i>
<i>Geotextile</i>	<i>02015</i>
<i>Stabilized Construction Access, Roads, Parking and Wash Areas</i>	<i>02020</i>
<i>Water-Permeable Sediment Filtration.....</i>	<i>02025</i>
<i>Rock Filter Dams</i>	<i>02030</i>

GENERAL SITE WORK

Clearing and Grubbing.....	02100
Removing Existing Pavements and Structures	02105
Borrow	02110
Embankment	02115
Excavation and Backfill for Structures.....	02120
Excavation and Backfill for Utilities.....	02125
Extra Price Unit Work for Excavation and Backfill	02130
Excavation for Roadway	02135
Utility Backfill Materials	02140
Cement-Stabilized Sand.....	02145

PIPING

Bar Wrapped Steel Cylinder Pipe	02200
Copper Tubing	02205
Corrugated Metal Pipe (CMP)	02210
Ductile Iron pipe and Fittings (DIP).....	02215
High Density Polyethylene Pipe (HDPE).....	02220
Prestressed Concrete Cylinder Pipe (PCCP)	02225
Polyethylene Pipe (PE).....	02230
Polyvinyl Chloride (PVC)	02235
Reinforced Concrete Box (RCB).....	02240
Reinforced Concrete Pipe (RCP).....	02245
Steel Pipe and Fittings	02250
Steel Pipe and Fittings for Large Diameter Water Lines.....	02255
Polyethylene Wrap	02260
Polyurethane Coatings on Steel and Ductile Iron Pipes	02265
Augering Water Pipe and Conduit	02270
Pipe and Casing Augering for Sanitary Sewers	02275
Trench Safety Systems	02280
Cathodic Protection	02285

MANHOLES

Cast-in-Place Concrete Manholes	02300
Precast Concrete Manholes	02305
Adjusting Manholes, Inlets and Valve Boxes to Grade	02310
Frames, Grates, Rings and Covers	02315
Manhole Rehabilitation	02320

POTABLE WATER SYSTEMS

Water Lines	02400

Butterfly Valves.....	02405
Gate Valves.....	02410
Air Valves (ARV)	02411
Check Valves	02412
Eccentric Plug Valves	02413
Pressure Reducing Valves (PRV).....	02415
Tapping Saddles and Sleeves (TS & V)	02420
Water Meters	02425
Water Tap and Service Line Installation	02430
Fire Hydrant Assemblies	02435
Valve Boxes, Meter Boxes and Meter Vaults.....	02440
Cut, Plug and Abandonment of Waterlines.....	02445
Hydrostatic Testing of Waterlines	02450
Disinfection of Waterlines	02455
Wet Connections	02460
Procedures for Bacteriological Testing	02465

SANITARY SEWER SYSTEMS

Gravity Sanitary Sewers	02500
Sanitary Sewer Service Stub-outs or Reconnections	02505
Sanitary Sewer Force Mains	02510
Abandonment of Sanitary Sewers	02515
Television Inspection of Sanitary Sewer Lines	02520
Acceptance Testing of Gravity Sanitary Sewer Lines	02525
Sanitary Sewer Line Cleaning	02530
Sanitary Sewer Lift Station	02535
Sanitary Sewer Point Repair.....	02540
Sanitary Sewer Pipe Lining.....	02545
Sanitary Sewer Pipe Bursting	02550
Sanitary Sewer Bypass Pumping.....	02555
Sanitary Sewer Line Obstruction Removal	02560
Lift Station Cleaning.....	02565
Submersible Sanitary Pump.....	02566
Pump Control System for Wastewater Lift Station.....	02567
Epoxy Liners for Sanitary Sewer Structures.....	02568

STORM SEWERS

Storm Sewer.....	02600
Cast-in-Place Inlets, Junction Boxes, Headwalls and Wingwalls.....	02605
Precast Concrete Inlets, Headwalls and Wingwalls.....	02610
Brick Manholes for Storm Sewers	02615
Storm Sewer Cleaning and Televising.....	02620

BASE COURSES

Cement-Stabilized Base Course.....	02700
Crushed Concrete Base Course.....	02705
Flexible Base Course	02710
Hot-Mix Asphaltic Concrete	02715
Lime-Stabilized Base Course	02720
Portland Cement-Stabilized Base Course	02725
Prime Coat.....	02730
Tack Coat	02735
Geotextile Stabilization	02740

PAVING

Asphaltic Concrete Paving.....	02800
Concrete Paving	02805
Concrete Median and Directional Islands	02810
Headers, Curb, Curb and Gutter.....	02815
Concrete Sidewalks	02820
Colored Concrete for Wheelchair Ramps	02825
Concrete Driveways	02830
Concrete Pavement Curing	02835
Concrete Pavement Joints.....	02840
Pavement Repair and Resurfacing.....	02845
Blast Cleaning of Concrete	02850
Raised Pavement Markers	02855
Thermoplastic Pavement Markings	02860
Traffic Signs.....	02865
Concrete Slab Raising	02870

LANDSCAPE

Turf Establishment.....	02900
Topsoil.....	02905
Hydromulch Seeding.....	02910
Sodding	02915
Tree Planting	02920
Landscape Irrigation	02925
Cedar Fence.....	02930
Chain Link Fence.....	02935
Fixed Knot Fabric Fence	02940
Wire Rope Boundary Fence	02945

DIVISION 03 – CONCRETE

CONCRETE

Mortar	03000

Grout.....	03005
Reinforcing Steel.....	03010
Structural Concrete.....	03015
Pre-Stressed Concrete Poles	03400

DIVISION 13 – SPECIAL CONSTRUCTION

Measurement and Control Instrumentation	13400

DIVISION 16 – ELECTRICAL

Electrical Systems Testing and Startup.....	16004
Electrical Selective Demolition	16020
Basic Electrical Materials and Methods	16050
Basic Electrical Submittal and O&M Requirements	16051
Electrical Identification	16052
Grounding and Bonding.....	16060
Low-Voltage Conductors and Cables.....	16121
Raceways and Boxes.....	16131
Conduit Fittings and Bodies	16132
Underground Ductbank	16133
Electrical Utility Service.....	16211
Short Circuit Coordination Study – Arc Flash Hazard Analysis	16212
Automatic Transfer Switch	16261
Enclosed Switches and Circuit Breakers.....	16410
Surge Suppression	16415
Motor Controllers	16420
Motor Control Center	16432
Control Panel.....	16433
Panelboards.....	16438
Pilot & Control Devices.....	16441
Low-Voltage Transformer	16460
Network Equipment.....	16710
Cellular Equipment.....	16772
Power Monitor	16911
PLC SCADA Equipment.....	16950

END OF SECTION

CITY OF FRIENDSWOOD REQUEST FOR PROPOSALS

COMPETITIVE SEALED PROPOSAL



TM

Lift Station No. 2 Rehabilitation Project CSP #2026-03

Competitive Sealed Proposals will be accepted either electronically or physically for the above-referenced project. This Request for Proposals, construction documents, specifications, and all necessary information may be obtained from the following: <https://www.ci.friendswood.tx.us/Bids.aspx> or www.civcastusa.com.

Sealed competitive proposals plainly marked **CSP #2026-03 Lift Station No. 2 Rehabilitation Project** shall be addressed to the City Secretary's Office, 910 S. Friendswood Drive, Friendswood, Texas 77546-4856. Submittals shall be accepted until **2:00 P.M., Thursday, March 26, 2026**, at which time there will be a public opening of the proposals where the City will read aloud the names of the offerors and any monetary proposals made by the offerors. Submittals will be accepted at the address listed above or electronically via www.civcastusa.com.

The City of Friendswood reserves the right to reject any or all submittals, to waive technical or legal deficiencies, and to accept any submittal that it may deem to be in the best interest of the City.

The City of Friendswood is asking qualified firms to prepare Competitive Sealed Proposals for the rehabilitation of Lift Station No. 2.

PART I: ADMINISTRATIVE INFORMATION

1.1 CITY CONTACTS

A. For all questions, legal, purchasing, technical and schedule please contact:

Name: Jildardo Arias, PE, CFM, ENV SP
Title: Director of Engineering
Phone: (281) 993-3411
Email: engineering@friendswood.com

1.2 SCHEDULE OF EVENTS

A. Invitation to Propose Issued	March 4, 2026
B. Non-Mandatory Pre-Proposal Meeting at 10:00 AM	March 16, 2026
C. Site Visit (Immediately following Pre-proposal meeting)	March 16, 2026
D. Written Questions due by 5:00 PM	March 19, 2026
E. Submittals due by 2:00 PM	March 26, 2026
F. Submittal Evaluation	March 27 to April 9, 2026
G. Contract Negotiations	April 10 to April 22, 2026
H. Posting of Recommendations to Council Agenda	April 28, 2026
I. Council approval	May 4, 2026

The non-mandatory pre-proposal meeting will be held at **10:00 am on Monday, March 16, 2026, at Friendswood City Hall (910 S. Friendswood Drive, Friendswood, TX 77546)**. A site visit will be held immediately following the pre-proposal meeting at the project location.

Pursuant to Resolution No. R2025-02, the City Council has delegated authority to the City Manager to determine and select the appropriate project delivery method in accordance with applicable provisions of the Texas Government Code.

PART II: PURPOSE

The City of Friendswood is asking qualified firms to prepare Competitive Sealed Proposals for the Rehabilitation of Lift Station No. 2. The scope of work includes:

- Installation of new riser piping and valves, cleaning and re-coating of the wet well, replacement of two pumps and new pump bases, rails, and guides; and
- Structural improvements include a new roof for the wet well, pipe supports for riser and force main piping, a new crane for Pumps 1-4, and a new above-ground valve pad. Electrical improvements include new junction boxes for each pump, new HVAC system for electrical room, and rehabilitation of the existing power distribution.

PART III: PROJECT SCOPE

The Project include:

- Rehabilitation of the existing discharge header including extending the discharge piping to a proposed valve pad located approximately 21-feet away from the edge of the wet well and reconnecting to the existing 22" HDPE force main, and
- Rehabilitation of the existing electrical control system, including associated instrumentation for both primary and secondary backup control.
- Cleaning and re-coating of the wet well,
- Installation of new riser piping,
- Installation of new pump bases, rails, and guides,
- Installation of a new influent line diffuser plate,
- Structural improvements for the wet well roof and sealing of existing penetrations,
- Installation of a crane for Pumps 1– 4,
- Installation of new junction boxes,
- Installation of odor control treatment,
- Installation of new HVAC system,
- Rehabilitation of the existing power distribution, and
- Replacement of two new small pumps within the wet well.

PART IV: PROPOSALS

Electronic Proposal Documents, including Contract Documents, Plans and Technical Specifications, are available for download on the City's website and CivCast at <https://www.ci.friendswood.tx.us/Bids.aspx> and <https://www.civcastusa.com/>. The documents are viewable without registration.

No plan fees or deposits are required for plans and proposal documents obtained through the City's website or CivCast.

The anticipated contract time for this project is three hundred sixty (360) calendar days. The estimated project budget is \$3,439,565. These figures are provided in accordance with Section 2269.153 of the Texas Government Code.

Offerors accept sole responsibility for downloading all the required documents, plans, specifications, proposal forms, and addenda required for submitting a proposal.

Each proposal must be accompanied by:

1. 00145 Competitive Sealed Proposal Form
2. Relevant Project Experience within the past five (5) years
3. Proposed Project Approach
4. Company organization chart, including those working directly on this project
5. Demonstrated ability to meet the project schedule
6. List of subcontractors, qualifications, and previous work experience Contractor
7. Quality assurance and safety record
8. Current project workload
9. Certificate of Insurance
10. Certificate of Interested Parties (Form 1295)
11. Statement of Conflicts of Interest
12. Conflict of Interest Questionnaire Form
13. Government Verification Form

No proposal may be withdrawn or terminated for a period of ninety (90) days subsequent to the proposal opening date without the consent of the City of Friendswood. Unless otherwise expressly provided herein, all references to "day(s)" shall mean calendar day(s).

Performance, Payment, and Maintenance Bonds: The successful Offeror must furnish Performance and Payment Bonds as required by Chapter 2253 of the Texas Government Code or other applicable law, as amended, upon the form included in the Contract Documents, in the amount of one hundred percent (100%) of the final contract price, such bonds to be executed by a corporate surety duly authorized to do business in the State of Texas, and named in the current list of "Treasury Department Circular No. 570", naming the City of Friendswood, Texas as Obligee. Additionally, the successful Offeror shall be required to provide a one-year Maintenance Bond for the improvements installed as part of this work, as provided in the Special Conditions of Agreement.

Equal Opportunity: All responsible Offerors having submitted complete proposals will receive consideration for award of contract without regard to race, color, religion, sex, or national origin.

Selection Criteria: The contract is to be awarded based on the provision of "Best Value" to the City. Within 45 days after the date the proposals are opened, the City will evaluate and rank each proposal using the following selection criteria:

1)	Cost Proposal	50%
2)	Experience with similar projects within past 5 years	10%
3)	Proposed Project Approach (Consider construction phasing and work sequence, schedule, proposed bypass pumping, and material, equipment, and delivery)	10%
4)	Experience and qualifications of key project personnel	10%
5)	Demonstrate ability to meet schedule on similar projects	10%
6)	Subcontractor qualifications and work history with general contractor	5%
7)	Quality Assurance and Safety Record	2%
8)	Current Workload	3%
	Total	100%

The City will select the Offeror that submits the proposal that offers the best value for the City based on:

- (1) the above-referenced selection criteria and the weighted value for those criteria in the request for proposal; and
- (2) its ranking evaluation.

Upon selection of a primary Offeror, the City will attempt to negotiate a contract with the selected Offeror. The City may discuss with the selected Offeror options for a scope or time modification and any price change associated with the modification. If the City is unable to negotiate a contract with the selected Offeror, the City shall, formally and in writing, end negotiations with that Offeror and proceed to the next Offeror in the order of the selection ranking until a contract is reached or all proposals are rejected.

The City may make such investigations as it deems necessary to determine the ability of the Offeror to perform the work, and the Offeror shall furnish the City all such information and data for this purpose as the City may request. The City reserves the right to reject any proposal if the evidence submitted by, or investigation of, such Offeror fails to satisfy the City that such Offeror is properly qualified to carry out the obligations of the contract and to complete the work contemplated therein. Conditional proposals will not be accepted.

The City of Friendswood reserves the right to award a contract based on its sole assessment and ranking of the above factors in its own best interests or reject any or all proposals.

A proposal that has been "opened" may not be changed for the purposes of correcting an error in the proposed price.

State Sales Tax: The City qualifies for exemption from State and Local Sales Tax pursuant to Section 151.311 of the Texas Tax Code for material incorporated into the project.

PART V: PROPOSALS

Please submit one (1) marked original, along with one (1) electronic copy on flash drive or CD by proposal opening time of 2:00 PM on Thursday, March 26, 2026. Flash drive or CD must contain only one (1) file in PDF format and must match the written response identically. Proposal shall be submitted to the address shown below. Submittals shall be signed in ink by a person authorized to bind the vendor in a contract. Proposal submittals will be accepted at the address listed below or electronically via www.civcastusa.com.

The City of Friendswood
City Secretary's Office
910 South Friendswood Drive
Friendswood, TX 77546
Monday - Thursday: 8:00 AM to 5:30 PM
Friday: 8:00 AM to 5:00 PM

Proposals sent via courier must be sealed in a separate envelope inside of the mailer. External envelope must be marked: CSP #2026-03.

To enable the City to efficiently evaluate the responses, it is IMPORTANT that respondents follow the required format in preparing their responses.

Each copy of the response shall be bound using a semi-permanent binding method, to ensure that pages are not lost. Pages shall be no larger than letter-size (8.5" by 11") or, if folded to that dimension, twice letter size (11" by 17"). Each section (defined below) shall be separated by a tabbed divider. Text shall be no smaller than 10 point. Margins shall be no smaller than 1 inch. Elaborate covers, binding, dividers, etc., are not required.

PART VI: SUBMITTAL PROCESS

- A. No Gratuities – Respondents shall not offer any gratuities, favors, or anything of monetary value to any official or employee of Friendswood for the purposes of influencing this selection. Any attempt by the respondent to influence the selection process by any means, other than disclosure of qualifications and credentials through the proper channels, shall be grounds for exclusion from the selection process.
- B. All Information True – Respondents represents and warrants to the City that all information provided in the response shall be true, correct and complete. Respondents who provide false, misleading, or incomplete information, whether intentional or not, in any of the documents presented to the City for consideration in the selection process shall be excluded.

00100-6

- C. Inquiries – Do not contact the City during the selection process to make inquiries about the progress of this selection process. Respondents will be contacted when it is appropriate to do so.
- D. Cost of Responses – The City will not be responsible for the costs incurred by anyone in the submittal of responses.
- E. No Obligation – The City reserves the sole right to (1) evaluate the responses submitted; (2) waive any irregularities therein; (3) reject any or all respondents submitting responses, should it be deemed in Friendswood's best interest; or (4) cancel the entire process.
- F. Insurance – The respondent shall have the appropriate liability insurance written by an insurer to transact insurance in the State of Texas.

END OF DOCUMENT

**SECTION 00101
INSTRUCTIONS TO OFFERORS**

1. Defined Terms

- 1.1. The term "Owner" hereinafter is defined as the City of Friendswood and is used interchangeably with the term "the City." Both terms are synonymous and refer to the City.
- 1.2. The term "Offeror" means one who submits a Proposal directly to Owner, as distinct from a sub-offeror, who submits a proposal to an Offeror. The term "Successful Offeror" means, on the basis of Owner's evaluation as hereinafter provided, the Offeror submitting a proposal that represents, in the Owner's opinion, the best value to the City. The term "Proposal Documents" includes the Invitation to Propose, Instructions to Offerors, the Proposal, and the proposed Contract Documents (including all Addenda issued prior to receipts of proposals).
- 1.3. The term "Engineer" hereinafter is defined as the professional designer or consultant and is used interchangeably with the term "Consultant". Both terms are synonymous and refer to the City.
- 1.4. The term "E-bid System" refers to the CivCast USA. This is a web-based system that provides all Proposal Documents electronically to potential Offerors and forms the pathway for interested Offerors to submit proposals in response to the advertisement and invitation. The term "e-bid" and/ or "electronic bid" means the Offerors' electronic proposal submitted to the Owner by way of the E-bid System. The terms "electronic bid" or "e-bid" are used inter-changeably to describe the above proposal process to submit an authorized proposal to the City in response to an Invitation to Propose.
- 1.5. The term "Project Management software" means the City's web-based contract administration and construction records management system used by involved parties to administer the project. This system serves as the web-accessed centralized information distribution hub for communications and document management, pay application processing and record repository for all project documentation. Operational instructions for this system will be issued to the successful Offeror at the pre-Construction Meeting.
- 1.6. All other definitions set out in the Contract Documents are applicable to terms used in the Proposal Documents.
- 1.7. Unless otherwise expressly provided herein, all references to "day(s)" shall mean consecutive calendar day(s).
- 1.8. The term "Alternate(s)" or "Add Alternate(s)" as used here interchangeably is defined as an additive work item that may be selected or rejected by the Owner based solely on the Owner's acceptance or rejection of the price proposed for this item. Alternate prices shall include all labor, material, equipment and overhead costs to perform the work as specified, complete in place. When selected by the Owner, the costs for an Alternate shall be added to the Base Proposal and made a part of the Contract price

2. Copies of Proposal Documents

- 2.1. Complete sets of electronic Proposal Documents are available for download. A Plan Holder will be notified immediately, by email, of any Addendums added to the project.

- 2.2. The Offeror accepts sole responsibility for ensuring that he obtains a full set of these documents by executing a full and complete download of the project documents. Downloading Proposal Documents automatically ensures receipt of any and all subsequent communications from the City and its Consultant.
- 2.3. Complete sets of Proposal Documents must be used in preparing Proposals; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Proposal Documents including, but not limited to all Addenda issued prior to opening the proposals.
- 2.4. Owner and Engineer, in making copies of Proposal Documents available on the above terms, do so only for the purpose of obtaining Proposals on the Work, and do not confer a license or grant for any other use.
- 2.5. Proposal Documents include, but are not limited to, construction documents, selection criteria and the weighted value for each criterion, estimated budget, project scope, estimated project completion date, and other documents required herein, e.g., Section 00145 Cost Proposal Form.
3. Examination of Contract Documents and Site
 - 3.1. It is the responsibility of each Offeror before submitting a Proposal, to (a) examine the Proposal Documents thoroughly, (b) visit the site to become familiar with local conditions that may affect cost, progress, performance or furnishing of the Work, (c) consider federal, state and local laws and regulations that may affect cost, progress, performance or furnishing of the Work, (d) study and carefully correlate Offeror's observations with the Contract Documents, and (e) notify Engineer of all conflicts, errors, omissions or discrepancies in the Contract Documents, (f) to recognize and plan for use of the City's "Project Management" software to administer the construction process and perform the work of the project.
 - 3.2. Any reports of explorations and tests of conditions at the site which have been utilized by the Engineer in preparation of the Contract Documents will be made available to Offerors for review, but such reports are not part of the Contract Documents. Offeror may not and should not rely upon the accuracy of the data contained in such reports, interpretations or opinions contained therein, or the completeness thereof, for the purposes of proposing or construction.
 - 3.3. Information and data reflected in the Contract Documents with respect to underground utilities, equipment or other underground facilities at or contiguous to the site is based upon information and data furnished to Owner and Engineer by owners of such underground facilities or others, and Owner does not assume responsibility for the accuracy or completeness thereof.
 - 3.4. Before submitting a Proposal, each Offeror will, at Offeror'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 of the Work and which Offeror deems necessary to determine its Proposal prices for performing and furnishing the Work in accordance with the Contract Time, Contract Price and other terms and conditions of the Contract Documents.

- 3.5. 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 Contractor in performing the Work are identified in the Contract Documents. All additional lands, access thereto or contractual arrangements for use by the Contractor required for temporary construction facilities or storage of materials and equipment are to be provided by Contractor. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by Owner unless otherwise provided in the Contract Documents.
- 3.6. The submission of a Proposal will constitute an incontrovertible representation by Offeror that Offeror has complied with every requirement of this Article 3, that without exception the Proposal is premised upon performing and furnishing all of the Work required by the Contract Documents and such means, methods, techniques, sequences or procedures of construction as may be indicated in, required by or reasonably inferred from the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
4. Interpretations and Addenda
 - 4.1. All questions about the meaning or intent of the Contract Documents are to be directed to City of Friendswood Engineering Department, or posted to CivCast. Interpretations or clarifications considered necessary by the City in response to such questions will be issued by Addenda delivered or transmitted by electronic means to all registered Offerors via CivCast and posted on CivCast and the City's website. Questions received less than five (5) days prior to the date for opening of Proposals may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.
 - 4.2. Addenda may also be issued to modify the Proposal Documents as deemed advisable by Owner or Consultant. Addenda will automatically be made available to all registered Offerors via CivCast and will be posted on CivCast and the City's website.
5. Contract Time
 - 5.1. The number of days in which the Work is to be Substantially Completed, as set forth in the Proposal form and the Standard Form of Agreement, subject to such extension of time as may be due under the terms and conditions of the Contract Documents ("Contract Time"). All references to "time" or "days" shall be interpreted as consecutive calendar days.
6. Liquidated Damages and Early Completion Bonus
 - 6.1. Provisions for liquidated damages and early completion bonus, if any, are set forth in the Standard Form of Agreement.
7. Substitute or "Or-Equal" Items
 - 7.1. The Proposal must be on the basis of the selected materials and equipment described in the Plans or specified in the Specifications without consideration of possible substitute or "or-equal" items. Whenever it is indicated in the Plans or specified in the Specifications that a substitute or "or-equal" item of material or equipment may be furnished or used by the Contractor if acceptable to Consultant. Application for such acceptance will not be considered by Consultant until after the Agreement becomes effective. All "or-equal" references shall be interpreted to mean "or approved equal". The procedure for submission of any such application by Contractor and consideration by Consultant is set

forth in the Contract Documents.

8. Proposal Form

- 8.1. The Proposal form (Section 00145 – Cost Proposal Form) is included with the Proposal Documents when downloaded. This Document must be printed and signed, as required below, and then uploaded as an Attachment to the Proposal.

All E-bids and physical proposals must be submitted via CivCast or submitted in person. All blanks on the Proposal form must be completed or filled in. The Offeror shall propose for all Alternates, if any. Incomplete Proposals may be cause for rejection.

- 8.2. Proposals by corporations must 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 must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation must be shown below the signature. **Once executed, the document is to be uploaded as an attachment to the Proposal.**

- 8.3. Proposals by partnerships must be executed in the partnership name and signed by a general partner, whose title must appear under the signature, and if a corporate general partner, executed as required above for corporations and the official address of the partnership must be shown below the signature. All names must be typed or printed below the signature. **Once executed, the document is to be uploaded as an attachment to the Proposal.**

- 8.4. The Offeror shall acknowledge receipt of all Addenda (the number of which must be filled in on the Proposal form).

- 8.5. The address and telephone number for communications regarding the Proposal must be shown on the Proposal form.

- 8.6. Proposal Security and Bonds: Security Bond in the form of Cashier's Check, Certified Check, or Proposal Bond payable to the City of Friendswood in the amount of 5% of the total cost proposal must accompany each proposal. Offerors submitting proposals electronically through the CivCast system shall scan and upload a copy of the sealed Proposal Bond as an attachment to their proposals. However, the **original Proposal Bond must be received in the City Secretary's Office before the proposal opening, else the Proposal will not be considered.**

9. Submission of Proposals

- 9.1. The place, date and/or time designated for opening Proposals may be changed in accordance with applicable laws, codes and ordinances. Any such changes to the Proposal Schedule shall be made by Addenda.

- 9.2. Electronic Proposals shall be submitted via CivCast. **Proposals submitted after the proposal date and time will be rejected.**

- 9.3. Physical proposals shall be submitted in-person at City Hall (910 S. Friendswood Drive, Friendswood, TX 77546) addressed to the City Secretary.

10. Modification and Withdrawal of Proposals

- 10.1. Prior to submission, E-bid Proposals may be modified or withdrawn without prejudice.
- 10.2. An Offeror may not modify or withdraw its Proposal by facsimile or verbal means. A withdrawn Proposal may be resubmitted prior to the designated time for opening Proposals.

- 10.3. If, within twenty-four (24) hours after Proposals are opened, any Offeror files a duly signed, written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material mistake in the preparation of its Proposal, that Offeror may request to withdraw its Proposal. Thereafter, if allowed to withdraw, that Offeror will be disqualified from further proposing on the Project to be provided under the Contract Documents.

11. Opening of Proposals

- 11.1. Electronic and physical proposals will be opened and read aloud publicly to identify the names of the offerors and their respective cost proposals, only. Proposals, in their entirety, shall be open for public inspection after the contract is awarded, with the exception of any trade secrets or confidential information contained therein, provided Offeror has expressly identified any specific information contained therein as being trade secrets or confidential information.

12. Proposals to Remain Subject to Acceptance

- 12.1. All Proposals will remain subject to acceptance for ninety (90) days after the day of the Proposal opening, but Owner may, in its sole discretion, release any Proposal prior to that date.

13. Award of Contract

- 13.1. Owner reserves the right to reject any and all Proposals, to waive any and all informalities not involving price, time or changes in the Work and to negotiate contract terms with the Successful Offeror. Owner may reject a proposal as non-responsive if:
1. Offeror improperly or illegibly completes or fails to complete all information required by the Proposal Documents;
 2. Offeror fails to sign the Proposal or improperly signs the Proposal;
 3. Offeror qualifies its Proposal;
 4. Offeror tardily or otherwise improperly submits its Proposal;
 5. Offeror fails to submit the Contractor's Qualification Statement and Technical Proposal as required under Section 3 of these Instructions to Offerors; or
 6. The Proposal is otherwise non-responsive.
- 13.2. Best Value. The Contract is to be awarded based on provision of "Best Value" to the Owner. Within 45 days after the date the proposals are opened, the City will evaluate and rank each proposal using the following selection criteria:

1)	Cost Proposal	50%
2)	Experience with similar projects within past 5 years	10%
3)	Proposed Project Approach (Consider construction phasing and work sequence, schedule, proposed bypass pumping, and material, equipment, and delivery)	10%
4)	Experience and qualifications of key project personnel	10%
5)	Demonstrate ability to meet schedule on similar projects	10%
6)	Subcontractor qualifications and work history with general contractor	5%
7)	Quality Assurance and Safety Record	2%
8)	Current Workload	3%
	Total	100%

The City will select the Offeror that submits the proposal that offers the best value for the City based on:

- (1) the above-referenced selection criteria and the weighted value for those criteria in the request for proposal; and
- (2) its ranking evaluation.

A contract to be awarded to the Offeror providing the Best Value may be let on either a lump sum basis or a unit cost basis dependent on the Proposal format.

- 13.3 Offeror is required to submit for approval a full schedule of values for the project as component of contract negotiations.
- 13.4 Within 45 days of the date of opening the proposals, the Owner will evaluate and rank each proposal with respect to the selection criteria contained in this Competitive Sealed Proposal document. After opening and ranking, an award may be made on the basis of the proposals initially submitted, without discussion, clarification or modification, or, the Owner may discuss with the selected responder, offers for cost reduction and other elements of the responder's proposal. If the Owner determines that it is unable to reach a contract satisfactory to the Owner with the selected offeror, then the Owner will formally terminate discussions with the selected offeror and proceed to the next offeror in order of selection ranking until a contract is reached or the Owner has rejected all proposals.
- 13.5 Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Proposal.
- 13.6 Offeror Attendance. The successful Offeror or its representative may be required to attend the City Council meeting at which the contract will be considered for award. Owner will establish a schedule for the award with Offeror.
- 14 Contract Security
 - 14.1 When the Successful Offeror delivers the executed Standard Form of Agreement to Owner, it must include the required Performance, Payment, and Maintenance Bonds (if required) by the Contract Documents. Bonds shall be on the forms provided herein.
- 15 Workers' Classification
 - 15.1 Texas Labor Code § 214.008 authorizes a penalty of \$200 per misclassified individual to be imposed on a person who contracts for certain services with a

governmental entity and fails to properly classify their workers and subcontractors.

16 Signing of Agreement

16.1 When Owner gives a Notice of Intent to Award to the Successful Offeror, it will be accompanied by the required number of unsigned counterparts of the Standard Form of Agreement, and the required Performance and Payment Bond forms. Within ten (10) days thereafter Contractor shall sign and deliver the required number of counterparts of the Standard Form of Agreement to Owner with the required Bonds. Owner shall deliver one fully signed counterpart to Contractor. There shall be no contract or agreement between Owner and the Successful Offeror until proper execution and attestation of the Standard Form of Agreement by authorized representatives of the Owner.

17 Pre-Proposal Conference

17.1 A pre-proposal meeting will be held as indicated in the Invitation to Propose.

18 Retainage

18.1 Provisions concerning retainage are set forth in the Contract Documents.

19 Award

19.1 The contract, if awarded, may be awarded to the eligible Offeror submitting the proposal that yields the best value to the Owner, complying with these Instructions to Offerors and other proposal requirements in the Documents. By submitting a Proposal, each Offeror agrees and consents that the Owner, in determining the Successful Offeror and its eligibility for the award, may consider the Offeror's experience conduct and performance under other contracts, reputation in the industry, safety record and other factors as stated below, which could affect the Offeror's qualifications to perform the work.

19.2 Pursuant to Statute 2269.151 of the Government Code, the City will evaluate the proposals to determine which proposal provides the best value for the Owner. In making said determination, the Owner will consider Criteria as further defined or explained in these Instructions to Offerors, including the Contractor's Qualification Statement and Safety Questionnaire, and Technical Proposal.

19.3 The average of the team member's individual rating values will be multiplied by the relative weighting points for each of the criteria below, and the total used to rank the Offerors. The Offeror with the highest ranking will be the Offeror considered the Offeror that provides the best value to the Owner and will be recommended to the City for contract award.

19.4 **Cost Proposal and Price – 50 Percent** - The Offeror with the lowest price will be rated accordingly. All other offerors will be awarded a rating value based on a weighted percentage based on the difference from the low offeror.

19.5 **Experience with similar projects within past 5 years – 10 Percent** – Offeror should provide at least three (3) references for the company and include in the references company name, contact person(s), address and telephone number for projects of similar contract price and scope within the past 5 years. Owner reserves the right to contact references for verification.

- 19.6 **Proposed project approach – 10 Percent** – Contractor should consider construction phasing, execution plan, equipment placement and use of construction limits, material storage and staging, lift station start up process and sequence, and site restoration/clean-up.
- 19.7 **Experience and qualifications of key personnel– 10 Percent** – Contractor must demonstrate the work experience and qualifications for the Project Manager and Superintendent. The evaluation is based on the number of years with the contractor, and the number of similar projects in which the employee performed task assigned to a Project Manager and Superintendent. The Offeror's reputation among other governmental entities, owners, suppliers, and sub-contractors will be considered for awarding of rating value points.
- 19.8 **Demonstrated ability to meet schedule on similar projects – 10 Percent** – Contractor must demonstrate past ability to meet contract schedule on similar projects included in this proposal. Contractor must provide a summary level schedule for past projects. Compare the Offeror firm's initial construction schedules with the final construction schedules. Based the schedules on calendar days, start with the Owner's Notice to Proceed and end with final completion of the work. Explain why if there is a disparity between the initial and final construction schedules.
- 19.9 **Experience, qualifications and work history of proposed major sub-contractors with General Contractor – 5 Percent** – A major sub-contractor is a sub-contractor that performs 5 percent or more of the Project. The contractor is required to provide references for similar projects where the subcontractor and Offeror have worked together in the last five years.
- 19.10 **Quality Assurance program and Safety Record – 2 Percent** - The Offeror and the subcontractors must provide owner with their Quality Assurance Program and Experience Modification Rate (EMR).
- 19.11 **Current Workload– 3 Percent** - Ability to commit to delivery of the project on schedule commitment to meeting the specific deadlines for the various components of the project will be awarded a rating value based on a weighted percentage based on the schedule offered. Summarize the Offeror firm's current workload and state the Offeror's availability to start construction of the project. Confirm equipment availability for the proposed work.
- 19.12 Maximum Possible Ranking Percentage = 100 Percent
- 19.13 In evaluating proposals, Owner will consider the qualifications of the Offerors, whether or not the proposals comply with the prescribed requirements, and such alternates, and other data (e.g., safety record, subcontractor qualifications, experience on similar projects, etc.), as requested in the Proposal.

END OF SECTION

PRE-BID MEETING OUTLINE

Project Name: Lift Station No. 2 Rehabilitation

Date: Monday, March 16, 2026

Time: 10:00am

<u>Item</u>	<u>Discussed</u>
1. Set out Sign-in sheet.	☐
2. Introductions.	☐
3. Give a brief description of the project.	☐
4. Ask Engineer if they would like to say a few words.	☐
5. Open floor for questions.	☐
6. Document questions and person that asked. If need be say that the question will be answered by addendum.	☐
7. If asked, have Engineer give cost estimate.	☐
8. Announce cutoff date and time for questions.	☐
9. Announce date and time that bids are due.	☐
10. Reiterate that the sealed Bids MUST be received at the City Secretary's Office, and no other location, so they can be time/date stamped.	☐
11. Plans and Specifications are available online.	☐
12. Confirm Sign-in sheet is complete and state that it will be shared via email.	☐
13. We will be at the project site for field observations and questions. (Relay directions to project site)	☐
14. This concludes the pre-bid meeting. Thank you for coming and good luck.	☐

END OF DOCUMENT

ADDENDUM

ADDENDUM NO. [INSERT ADDENDUM #]

Date of Addendum: [INSERT DATE]

PROJECT NAME: Lift Station No. 2 Rehabilitation

PROJECT NO: [INSERT PROJECT #]

BID DATE: [INSERT DATE OF BID]

FROM: [INSERT CONTACT]
[INSERT FIRM]
[INSERT ADDRESS]
[INSERT CITY, STATE, ZIP]

TO: Prospective Bidders

This Addendum forms a part of the Bidding Documents and will be incorporated into the Contract documents, as applicable. Insofar as the original Project Manual and Drawings may conflict, this Addendum governs.

CHANGE IN BID DATE

ADDENDUM CONTENT

CHANGES TO CONTRACT TIME

ADDENDUM CONTENT

CHANGES TO DRAWINGS

ADDENDUM CONTENT

CLARIFICATIONS

ADDENDUM CONTENT

END OF DOCUMENT

ACKNOWLEDGEMENT OF ADDENDA

Date: [INSERT DATE]

To: Prospective Respondents

From: [INSERT CONTACT]
[INSERT POSITION]
City of Friendswood

Re: [INSERT RFQ, RFP OR ITB AND #]

This signed document shall be included in the final Bid submittal. This is to serve as an official acknowledgment any addenda that were issued have been received and the contents understood.

Please list addenda by number and date.

Name: _____
(signature)

Name: _____
(printed name)

Name: _____
(company name)

END OF DOCUMENT

INSURANCE REQUIREMENTS

PART I: GENERAL

- 1.1 Throughout the term of the Executed Agreement, the Contractor, at their own expense, shall purchase, maintain, and keep in force and effect insurance against claims for injuries to, or death of, persons, or damages to property which may arise out of or result from the Contractor's operation and/or performance of the Work under stated agreement, whether such operations and/or performance be by the Contractor, their agents, representatives, volunteers, employees, or subcontractors or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable.
- 1.2 The Contractor's insurance cover shall be primary insurance with respect to the City, its officers, agents, and employees, including the City. Any insurance maintained by the City, its officials, agents, and employees shall be considered in excess of the Contractor's insurance and shall not contribute to it. Further, the Contractor shall include the City of Friendswood and all subcontractors as an additional insured under its commercial general liability policies or furnish separate certificates and endorsements for each subcontractor. All coverage for subcontractors shall be subject to all of the requirements stated herein.
- 1.3 The following is a list of standard insurance policies along with their respective minimum coverage amounts required per the Contract Documents:
 - A. Workers' Compensation: Statutory.
 - B. Employer's Liability: \$500,000.
 - C. Comprehensive General Liability:
 - a. Bodily Injury:
 1. \$500,000 per Occurrence.
 2. \$1,000,000 per Aggregate Occurrence.
 - b. Property Damage:
 1. \$500,000 per Occurrence.
 2. \$1,000,000 per Aggregate Occurrence.
 - D. Comprehensive Automobile Liability:
 - a. Bodily Injury:
 1. \$500,000 per Each Person.
 2. \$1,000,000 per Accident; or
 3. \$1,000,000 Combined Single Limit (CSL).
 - b. Property Damage:
 1. \$500,000 per Accident.
- 1.4 Upon execution of Standard Agreement, the Contractor shall file with the City valid Certificates of Insurance and endorsements acceptable to the

City. Such Certificates shall contain a provision that coverage afforded under the policies will not be canceled, suspended, voided, or reduced until at least thirty days (30 D) prior written notice has been given to the City.

- 1.5 The Contractor shall also file with the City valid Certificates of Insurance covering all Subcontractors.
- 1.6 The following general requirements shall apply to all policies:
 - A. AM Best Rating of A- or better.
 - B. Only insurance carriers licensed and admitted to do business in the State of Texas shall be accepted.
 - C. The City of Friendswood, its officials, and employees are to be added as an Additional Insured to liability policies.
 - D. Certificates of Insurance showing evidence of insurance coverage shall be provided to the City's representative within ten (10) Working Days after this Agreement is executed.
 - E. All other requirements set in Document 000115[INSERT B, C OR P] - Instructions to [INSERT BIDDERS, OFFERORS OR PROPOSERS].

PART II: NOT USED

PART III: NOT USED

END OF DOCUMENT

CHILD SUPPORT AFFIDAVIT

“Under Texas Family Code, Section 231.006 a sole proprietorship, corporation or other entity in which a sole proprietor, partner, majority shareholder of a corporation or an owner of ten percent (10%) or more of an other business entity is thirty (30) days or more delinquent in paying child support under a court order or written repayment agreement is not eligible to bid on or receive a state contract.”

To comply with Section 231.006, the affidavit below shall be signed by the person who is authorized to sign and submit a bid, and thereby bind the Bidder, and must be returned with the Bid. A failure to do so will result in the disqualification of the Bid.

“I, [INSERT SIGNEE'S NAME], the [INSERT SIGNEE'S TITLE], am authorized to sign this Bid on behalf of [INSERT CONTRACTOR NAME], a [INSERT SOLE PROPRIETORSIP/PARTNERSIP/CORPORATION/OR OTHER ENTITY].

I certify that no [INSERT SOLE PROPRIETOR/PARTNER/MAJORITY SHAREHOLDER OR TEN PERCENT (10%) OR MORE OWNER OR OTHER ENTITY] is thirty (30) days or more delinquent in child support payment required by court order or written repayment agreement.”

[INSERT SIGNEE'S NAME]

Date

SWORN AND SUBSCRIBED by me on this _____ day of _____,
A. D. _____.

Notary Public in and for _____ County, Texas.

Notary Public Signature

Print or Type Notary Public Name

NOTARY SEAL

My Commission Expires: _____

END OF DOCUMENT

BIDDER'S BOND

STATE OF TEXAS §
 § Bond Number:[INSERT BOND #]
COUNTY OF GALVESTON §

THAT [INSERT BIDDERS NAME] ("Principal"), as Principal, and **[INSERT BONDING COMPANY NAME]** ("Surety"), as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Friendswood, a home rule municipal corporation of Harris and Galveston Counties ("Obligee"), in the sum of: **[INSERT WRITTEN AMOUNT OF 5% OF TOTAL BID, INCLUDING ANY ALLOWANCES AND ALTERNATIVES]** Dollars (\$**[INSERT BOND AMOUNT IN NUMBERS]**) for the payment whereof said Bidder and Surety do bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the PRINCIPAL has submitted on or about this day a bid to perform the following:

PROJECT NAME: Lift Station No. 2 Rehabilitation
CSP NUMBER: CSP 2026-03
PROJECT LOCATION: 1306 Deepwood Dr

in accordance with the Contract Documents, including all drawings, specifications, and terms and conditions related thereto to which reference is hereby made.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if said Principal shall faithfully enter into such written contract and provide all required submittals, including bonds and insurance, then this obligation shall become null and void; otherwise, it shall remain in full force and effect.

IT IS EXPRESSLY UNDERSTOOD AND AGREED that if Principal should withdraw its Bid anytime after such Bid is opened and before official rejection of such Bid or, if successful in securing the award thereof, said Principal should fail to enter into the Contract and furnish required submittals, including satisfactory Performance, Payment and Maintenance Bonds, along with certificate(s) of insurance evidencing required coverages and limits, the Obligee, in either of such events, shall be entitled and is hereby given the right to collect the full amount of this Bid Bond as liquidated damages, which is hereby acknowledged as the amount of damages which will be suffered by Obligee on account of the failure of Principal to perform such obligations, the actual amount of such damages being difficult to ascertain.

PROVIDED, the Surety, for value received, hereby stipulates and agrees that the obligation of said Surety and its bond shall be in no way impaired or affected by any extension of the time within which the Obligee may accept such Bid, and said Surety does hereby waive notice of any such extension

PROVIDED FURTHER, that if any legal action be filed upon this Bond, venue shall lie in Galveston County, Texas.

IN WITNESS THEREOF, the Bidder and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

Principal/Contractor

Surety

By:_____

By: _____
(Attorney-in-Fact Signature)

Printed Name:_____

Printed Name:_____

Address:_____

Address:_____

ATTEST:

ATTEST:

Secretary (if corporation)/Witness

Secretary (if corporation)/Witness

[Corporate Seal if corporation]

[Surety Seal]

Registered Agent of Surety for Delivery
of notice and service of process:

Name: _____

Address:_____

Phone Number:_____

**NOTE: Attach Certified Copy of Power of Attorney
END OF DOCUMENT**

COST PROPOSAL

RFP

To: The Honorable Mayor and City Council of the City of Friendswood
City Hall
910 South Friendswood Drive
Friendswood, Texas 77546

Project: Lift Station No. 2 Rehabilitation Project
Proposal No.: CSP 2026-03

Proposer: _____
(Print or type full name of proprietorship, partnership, corporation, or joint venture.)

PART I: OFFER

- 1.1 Total Cost Proposed: Having examined the Project location and all matters referred to in the Proposal Documents for the Project, we, the undersigned, offer to enter into the Owner's form of Contract without material modification to perform the Work for the Total Cost Proposed shown on the signature page of this Document.
- 1.2 Security Deposit: Included with this Cost Proposal is a Security Deposit in the amount of five percent (5%) of the Total Cost Proposed.
- 1.3 Period for Acceptance of Proposal: This offer is open to acceptance and is irrevocable for ninety (90) days from the opening date of this proposal. That period may be extended by mutual written agreement of the City and the Offeror.
- 1.4 Addenda: All Addenda have been received. Modifications to the Construction Documents have been considered and all related costs are included in the Total Cost Proposed.
- 1.5 This document constitutes a government record, as defined by § 37.01 of the Texas Penal Code. Submission of a false government record is punishable as provided in § 37.10 of the Texas Penal Code.

PART II: CONTRACT TIME

- 2.1 If offer is accepted, the Contractor shall achieve the Date of Substantial Completion within THREE HUNDRED THIRTY (330) calendar days after the

date of commencement of the Work as stipulated in the Notice To Proceed, subject to adjustments of Contract Time as provided in the Contract.

- 2.2 It is also understood and agreed that the Work shall be completed in full within THREE HUNDRED SIXTY (360) calendar days after the date of commencement of the Work as stipulated in the Notice To Proceed, subject to adjustments of Contract Time as provided in the Contract.

PART III: CONTRACT PRICE

- 3.1 Total Cost Proposed has been Calculated by the Offeror, using the following component prices and process (Print or Type numerical amounts).
- 3.2 The Total Cost Proposed for the Project shall be a factor for Contract of the successful low Offeror.

PART IV: ACKNOWLEDGEMENT

- 4.1 The undersigned, as the Offeror, declares that the only person or parties interested in this proposal as principals are those named herein, that this proposal is made without collusion with any other person, firm or corporation; that he has carefully examined the Request for Proposals, Instructions to Offerors, this Cost Proposal Form, the Agreement, the General Conditions, the Supplementary Conditions, The Technical Specifications, the Special Provisions, and the Drawings therein referred to and has carefully examined the locations, conditions, and classes of materials of the proposed work; and agrees that he shall provide all necessary labor, machinery, tools, apparatus and other items incidental to construction and will do all the work and furnish all the materials called for in the Contract and the Technical Specifications in the manner prescribed herein and according to the requirements of the City's Engineer as therein set forth.
- 4.2 It is understood that the following quantities of work to be done at unit prices are approximate only and are intended principally to serve as a guide in evaluating proposals. It is further understood that all items of work for which there are no specific pay items are included in the proposal items shown on this Cost Proposal Form and are considered incidental to the Work.
- 4.3 It is further understood that the quantities of work to be done at the unit prices and materials to be furnished may be considered necessary, in the opinion of the City's Engineer, to complete the work fully as planned and contemplated, and that all quantities of work, whether increased or decreased are to be performed at the unit prices set forth below except as provided for in the specifications.

- 4.4 It is further agreed that the lump sum prices may be increased to cover additional work ordered by the City's Engineer or the City, but not shown on the Drawings or required by the Technical Specifications, in accordance with the provisions of the General Conditions. Similarly, they may be decreased to cover the deletion of work so ordered.
- 4.5 If Offeror whose proposal is accepted by the City fails to execute the Agreement and/or fails to execute a Performance Bond and a Payment Bond within ten (10) days of Notice to Award, the proposal security shall become the property of the City, and shall be considered as payment for damages due to delay, and other inconveniences suffered by the City on account of such failure of the Offeror. Further, should the City bring suit in court to enforce any terms of this proposal, it is agreed that the Offeror or his surety shall pay to the City the cost and reasonable attorney's fees.
- 4.6 In the event of the award of a contract to the undersigned, the undersigned shall furnish a Performance Bond for the full amount of the Contract, to secure proper compliance with the terms and provisions of the Contract, to insure and guarantee the Work until final completion and acceptance, and shall furnish a Payment Bond in the same amount to guarantee payment of all lawful claims for labor performed and materials furnished in fulfillment of the Contract.
- 4.7 The work proposed to be done shall be accepted when fully complete and finished in accordance with the Drawings and Technical Specifications to the satisfaction of the City. The undersigned certified that the prices contained in this Cost Proposal Form have been carefully checked and submitted as correct and final.
- 4.8 Unit and lump sum prices shall be shown in words and figures for each item listed in this proposal, and in the event of discrepancy, the words shall control. Should prices on any item be omitted, the right to apply the lowest prices submitted by any other Offerors for the omitted items in payment for work done under this proposal.
- 4.9 Offeror understands that the City reserves the right to reject any and all proposals and to waive any informalities in the competitive sealed proposal process. In addition, the City reserves the right to award the Contract to the Offeror that provides the best value to the City based upon the criterion specified in the Instructions to Offerors.
- 4.10 Proposals shall be good for ninety (90) days from the date of the proposal opening.

PART V: UNIT PRICE COST PROPOSAL FORMS

- 5.1 The following forms shall be included in this Cost Proposal Form.

00145-3

UNIT PRICE COST PROPOSAL

Item No.	Description of Item w/Unit Bid Price Written in Words	Qty.	Unit	Unit Bid Price	Extended Amount
1	Mobilization, Bonds, and Insurance (5%)	1	LS		
@ _____					
2	Install and Maintain Trench Safety System	37	LF		
@ _____					
3	Furnish, Install, and Maintain Bypass Pumping	1	LS		
@ _____					
4	Furnish and Install 1" Air Release Valves	4	EA		
@ _____					
5	Furnish and Install 3" Air Release Valves	2	EA		
@ _____					

UNIT PRICE COST PROPOSAL FORM

Item No.	Description of Item w/Unit Bid Price Written in Words	Qty.	Unit	Unit Bid Price	Extended Amount
6	Furnish and Install 12" Plug Valve	4	EA		
@					
7	Furnish and Install 12" Swing Check Valve	4	EA		
@					
8	Furnish and Install 12" Class 350 Ductile Iron Piping	48	LF		
@					
9	Furnish and Install 24" Swing Check Valve	2	EA		
@					
10	Furnish and Install 24" Plug Valve	4	EA		
@					

UNIT PRICE COST PROPOSAL FORM

Item No.	Description of Item w/Unit Bid Price Written in Words	Qty.	Unit	Unit Bid Price	Extended Amount
11	Furnish and Install 24" Class 350 Ductile Iron Piping	125	LF		
@ _____					
12	Furnish and Install Class 350 Ductile Iron Fittings	6	TON		
@ _____					
13	Clean and Re-Coat Wet Well with Epoxy Lining	1	LS		
@ _____					
14	Furnish and Install 12" Sch. 40 Stainless Steel 304 Riser Piping	120	LF		
@ _____					
15	Furnish and Install 24" Sch. 40 Stainless Steel 304 Riser Piping	60	LF		
@ _____					

UNIT PRICE COST PROPOSAL FORM

Item No.	Description of Item w/Unit Bid Price Written in Words	Qty.	Unit	Unit Bid Price	Extended Amount
16	Replace Pump Bases, Rails, and Guides for Existing Pumps (Pumps #5 and #6)	2	EA		
@					
17	Furnish and Install 1895 gpm Submersible Pumps (Pumps #3 and #4)	2	EA		
@					
18	Furnish and Install 36" Influent Line Diffuser Plate	1	LS		
@					
19	Furnish and Install Jib Crane for Pumps # 1 - 4	1	EA		
@					
20	Structural Improvements Furnish and install all work shown in construction documents including: excavation for valve pad, prepare subgrade, concrete piers, CLSM/flowable at existing header, demolish upper slab, dewatering, valve pad, new upper slab, protective coating, and jib crane foundation	1	LS		

00145-7

@ _____		

UNIT PRICE COST PROPOSAL FORM

<u>Item No.</u>	<u>Description of Item w/Unit Bid Price Written in Words</u>	<u>Qty.</u>	<u>Unit</u>	<u>Unit Bid Price</u>	<u>Extended Amount</u>
21	Electrical Improvements Provide and install all work shown in construction documents including: New monitor control center, lift station control panel, lighting, conduit and feeders, electrical service equipment, junction boxes, surge protector, utility service rack, HVAC bard unit, relocation of equipment / phasing modifications, panelboard, circuit breaker, transformer, terminal boxes, complete primary/backup control system, select demolition, and all equipment for a fully functional lift station system.)	1	LS		
@ _____					
22	Programming Services Include allowance for SCADA programming per construction documents and as shown.	1	ALLOW		
@ _____					
23	Electrical Service Include allowance for electrical service by local utility. Exact amount will be reimbursed to contractor upon submittal of invoice from electric utility. All new accounts shall be opened by contractor and transferred to owner upon substantial completion.	1	ALLOW		

00145-8

**CITY OF FRIENDSWOOD
TECHNICAL SPECIFICATIONS**

**UNIT PRICE
COST PROPOSAL**

@ _____		
24	Abandon in Place Existing Discharge Header and Existing Force Main	1 LS
@ _____		
25	Furnish and Install Precast Concrete Stairs w/ Integrated Handrail	1 LS
@ _____		

UNIT PRICE COST PROPOSAL FORM

Item No.	<u>Description of Item w/Unit Bid Price Written in Words</u>	<u>Qty.</u>	<u>Unit</u>	<u>Unit Bid Price</u>	<u>Extended Amount</u>
26	Site Grading	1	LS		
@ _____					
27	6" Crushed Concrete with Geotextile Liner	131	SY		
@ _____					
28	Connect to Existing Force Main	1	LS		

00145-9

**CITY OF FRIENDSWOOD
TECHNICAL SPECIFICATIONS**

**UNIT PRICE
COST PROPOSAL**

@ _____		
29	Remove and Dispose Ex. Electrical Concrete Pad	3 SY
@ _____		
30	Remove and Dispose Gravel Driveway	66 SY
@ _____		

UNIT PRICE COST PROPOSAL FORM

Item No.	Description of Item w/Unit Bid Price Written in Words	Qty.	Unit	Unit Bid Price	Extended Amount
31	Remove and Dispose Chain Link Fence	99	LF		
@ _____					
32	Prepare, Implement, and Maintain Stormwater Pollution Prevention Plan	1	LS		
@ _____					
33	Install Hydromulch/Stabilization	1	LS		

00145-10

**CITY OF FRIENDSWOOD
TECHNICAL SPECIFICATIONS**

**UNIT PRICE
COST PROPOSAL**

@ _____		

5.2 Insert a lump sum figure for each of the alternates listed in TABLE 5.2 – ALTERNATES listed below:

Alternate Number	Alternate Description	Alternate Lump Sum
01210-1		\$
01210-2		\$
01210-3		\$
01210-4		\$
01210-5		\$
TOTAL ALTERNATE PRICE		\$

5.3 ADDENDA ACKNOWLEDGEMENT

ADDENDA NUMBER	ADDENDA DATE	DATE RECEIVED	OFFERORS INITIALED
1			
2			
3			
4			
5			

5.4 ALLOWANCES

1. Allowance Type

5.5 PRICES

- A. TOTAL BASE COST PROPOSED _____
- B. TOTAL ALTERNATES _____
- C. TOTAL ALLOWANCES _____
- D. TOTAL COST PROPOSED _____

PART VI: SIGNATURES

6.1 By signing this Document, I agree that I have received and reviewed all Addenda and considered all costs associated with the Addenda in calculating the Total Cost Proposed.

Company: _____
(Print Company Name)

Signed: _____
(Authorized Signature)

By: _____
(Print Name)

Title: _____
(Print Title)

ATTEST:

(Seal, if Offeror is a Corporation)

(Mailing Address)

(City, State and Zip Code)

(Delivery Address)

(City, State and Zip Code)

(Telephone Number)

(email Address)

PART VII: AFFIDAVIT

All pages in Offers' cost proposal containing statements, letters, etc. shall be signed by a duly authorized officer of the company, whose signature is binding on the proposal.

The undersigned offers and agrees to one (1) of the following:

- ☐ I hereby certify that I do not have outstanding debt with the City of Friendswood. Further, I agree to pay succeeding debts as they become due during this agreement.
- ☐ I hereby certify that I do have outstanding debts with the City of Friendswood and agree to pay said debts prior to execution of this agreement.
- ☐ I hereby certify that I do have outstanding debts with the City of Friendswood and agree to enter into an agreement for the payment of said debts. I further agree to pay succeeding debts as they become due.

Name of Offeror: _____

Title: _____

Address: _____

City/State/Zip: _____

Telephone: _____

Email: _____

Signature: _____

SWORN AND SUBSCRIBED by me on this _____ day of _____,
A. D. 20____.

Notary Public in and for _____ County, Texas.

Notary Public Signature

Print or Type Notary Public Name

NOTARY SEAL My Commission Expires: _____

END OF DOCUMENT

TOTAL STIPULATED PRICE FORM

To: The Honorable Mayor and City Council of the City of Friendswood
City Hall
910 South Friendswood Drive
Friendswood, Texas 77546

Project: Lift Station No. 2 Rehabilitation

Project No.: [INSERT PROJECT #]

Bid No.: [INSERT BID #]

Bidder: _____
(Print or type full name of proprietorship, partnership, corporation, or joint venture.)

PART I: OFFER

- 1.1 Total Stipulated Price: Having examined the Project location and all matters referred to in the Bid Documents for the Project, we, the undersigned, offer to enter into a Contract to perform the Work for the Total Stipulated Price shown on the signature page of this Document
- 1.2 Security Deposit: Included with the Bid is a Security Deposit in the amount of five percent (5%) of the Total Stipulated Price.
- 1.3 Period for Bid Acceptance: This offer is open to acceptance and is irrevocable for sixty days (60 D) from Bid Date. That period may be extended by mutual written agreement of the City and Bidder.
- 1.4 Addenda: All Addenda have been received. Modifications to Bid Documents have been considered and all related costs are included in the Total Bid Price.
- 1.5 This document constitutes a government record, as defined by § 37.01 of the Texas Penal Code. Submission of a false government record is punishable as provided in § 37.10 of the Texas Penal Code.

PART II: CONTRACT TIME

- 2.1 If offer is accepted, Contractor shall achieve Date of Substantial Completion within [INSERT DAYS IN WORDS] ([INSERT # DAYS]) [INSERT WORKING OR CALENDAR] Days after the date of commencement of the Work as stipulated in Document 00725B – Notice To Proceed, subject to adjustments of Contract Time as provided in the Contract.

- 2.2 It is also understood and agreed that the Work shall be completed in full within [INSERT DAYS IN WORDS] ([INSERT # DAYS]) [INSERT WORKING OR CALENDAR] Days after the date of commencement of the Work as stipulated in the Notice To Proceed, subject to adjustments of Contract Time as provided in the Contract.

PART III: CONTRACT PRICE

- 3.1 Total Stipulated Price has been calculated by Bidder, using the following component prices and process (Print or Type numerical amounts).
- 3.2 The Base Stipulated Price for the Bid will be the determining factor for Contract of the Successful Low Bidder.

A. The Base Stipulated Price for this bid is:

Figures: \$ _____

Written: _____

- 3.3 Insert a lump sum figure for each of the alternates list in TABLE 3.3 – ALTERNATES listed below:

Alternate Number	Alternate Description	Alternate Lump Sum
1		\$
2		\$
3		\$
4		\$
5		\$
TOTAL ALTERNATE PRICE		\$

3.4 Insert a lump sum figure for each of the allowances list in TABLE 3.4 – ALLOWANCES listed below:

Cash Allowance Number	Cash Allowance Description	Cash Allowance Extended Total
01210-1		\$
01210-2		\$
01210-3		\$
01210-4		\$
01210-5		\$
TOTAL ALLOWANCE PRICE		\$

3.5 ADDENDA ACKNOWLEDGEMENT

ADDENDA NUMBER	ADDENDA DATE	DATE RECEIVED	BIDDERS INITIALED
1			
2			
3			
4			
5			

3.6 BID PRICES

A. BASE STIPULATED PRICE _____

B. TOTAL ALTERNATES _____

C. TOTAL ALLOWANCES _____

D. TOTAL STIPULATED PRICE _____

PART IV: SIGNATURES

- 4.1 By signing this Document, I agree that I have received and reviewed all Addenda and considered all costs associated with the Addenda in calculating the Total Bid Price. I furthermore state that I have reviewed all the Contract Documents, Drawings and Project site and have performed a constructability review.

Company: _____
(Print Company Name)

Signed: _____
(Authorized Signature)

By: _____
(Print Name)

Title: _____
(Print Title)

ATTEST:

(Seal, if Bidder is a Corporation)

(Mailing Address)

(City, State and Zip Code)

(Delivery Address)

(City, State and Zip Code)

(Telephone Number)

(email Address)

PART V: AFFIDAVIT

All pages in offers' bid proposal containing statements, letters, etc. shall be signed by a duly authorized officer of the company, whose signature is binding on the proposal.

The undersigned offers and agrees to one (1) of the following:

- ☐ I hereby certify that I do not have outstanding debt with the City of Friendswood. Further, I agree to pay succeeding debts as they become due during this agreement.
- ☐ I hereby certify that I do have outstanding debts with the City of Friendswood and agree to pay said debts prior to execution of this agreement.
- ☐ I hereby certify that I do have outstanding debts with the City of Friendswood and agree to enter into an agreement for the payment of said debts. I further agree to pay succeeding debts as they become due.

Name of Bidder: _____

Title: _____

Address: _____

City/State/Zip: _____

Telephone: _____

Signature: _____

SWORN AND SUBSCRIBED by me on this _____ day of _____,
A. D. 20____.

Notary Public in and for _____ County, Texas.

Notary Public Signature

Print or Type Notary Public Name

NOTARY SEAL My Commission Expires: _____

END OF DOCUMENT

00150-5

BID TABULATION SHEET

Bid Tabulation For:							
CONTRACTOR NAME:				Company 1		Company 1	
Item Number	Item Description	Unit	Unit Amount	Unit Price	Extended Amount	Unit Price	Extended Amount
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
SUBTOTAL BASE BID				\$0.00		\$0.00	
01210-1							
01210-2							
01210-3							
01210-4							
01210-5							
01210-6							
01210-7							
SUBTOTAL ALLOWANCES				\$0.00		\$0.00	
A.	BASE BID			\$0.00		\$0.00	
B.	ALTERNATES			\$0.00		\$0.00	
C.	TOTAL STIPULATED PRICE			\$0.00		\$0.00	

END OF DOCUMENT

00155-1

THE STATE OF TEXAS §
 §
COUNTY OF GALVESTON §

**STANDARD AGREEMENT FOR
CONTRACTING SERVICES**

THIS AGREEMENT, entered into as of this [INSERT DATE] day of [INSERT MONTH], [INSERT YEAR], by and between the City of Friendswood, Texas (hereinafter called the "CITY") acting herein by its Mayor, duly authorized by approval of the City Council of the City of Friendswood and [INSERT CONTRACTOR NAME], [INSERT ADDRESS], [INSERT CITY, STATE AND ZIP] (hereinafter called the "CONTRACTOR") acting herein by [INSERT PRINCIPAL NAME], [INSERT PRINCIPAL TITLE] hereunto duly authorized:

WITNESSETH THAT:

WHEREAS, the CITY and the CONTRACTOR in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE I: WORK

- 1.1 The Contractor shall complete all the Work as specified in the Contract Documents. The Work is generally described as follows:

Lift Station No. 2 Rehabilitation

- 1.2 The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

[INSERT GENERAL DESCRIPTION OF TYPE]

ARTICLE II: DESIGN PROFESSIONAL

- 2.1 The Project has been designed by **Kimley-Horn & Associates, Inc.**, **11700 Katy Fwy, Suite 800, Houston, TX, 77091**, who is hereinafter called the Design Professional and who is to act as the City's Representative, assume all duties and responsibilities and shall have the rights and authority assigned to the Design Professional in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

ARTICLE III: CONTRACT TIME

- 3.1 The Work shall be Substantially Complete within [INSERT WRITTEN DAYS] ([INSERT# DAYS]) [INSERT WORKING OR CALENDAR] Days after the date when the Contract Time commences to run as provided by

the General Conditions.

- 3.2 The Work shall have Final Completion and be ready for Final Payment in accordance with the General Conditions within [INSERT WRITTEN DAYS] ([INSERT # DAYS]) [INSERT WORKING OR CALENDAR] Days after the date when the Contract Time commences to run as provided by the General Conditions.

ARTICLE IV: LIQUIDATED DAMAGES

- 4.1 The City and the Contractor recognize that time is of the essence of this Agreement and that the City shall suffer financial loss if the Work is not completed within the time specified in Article 3.1 above, plus any extensions thereof allowed in accordance with the General Conditions. They also recognize the delays, expense and difficulties involved in proving the actual loss suffered by the City if the Work is not completed on time. Accordingly, instead of requiring any such proof, the City and the Contractor agree that as liquidated damages for delay (not as a penalty) the Contractor shall pay the City FIVE HUNDRED Dollars (\$500.00) for each day that expires after the time specified in Article 3.1, in this Agreement, for Substantial Completion until the Work is Substantially Complete.
- 4.2 After Substantial Completion, if the Contractor shall neglect, refuse or fail to complete the remaining Work within the time specified in Article 3.2 for Final Completion and readiness for Final Payment or any proper extension thereof granted by the City, the Contractor shall pay City Five Hundred Dollars (\$500.00) for each day that expires after the time specified in Article 3.2, in this Agreement, for Final Completion until the Work is Finally Complete and ready for Final Payment.
- 4.3 Contractor agrees any assessed liquidated damages may be offset against retainage held by the City.

ARTICLE V: CONTRACT PRICE

- 5.1 The City shall pay the Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the sum of the amounts determined pursuant to Document [INSERT 00145 OR 00150] – [INSERT UNIT OR TOTAL STIPULATED] Price Form.
- 5.2 TOTAL AMOUNT OF BID is [INSERT WRITTEN DOLLARS] Dollars and [INSERT WRITTEN CENTS] Cents (\$[INSERT # AMOUNT]).
- 5.3 As provided in the General Conditions estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by the City as provided in the General Conditions. Unit prices

have been computed as provided in the General Conditions. Unit prices specified as per lump sum have been computed in accordance with the General Conditions.

ARTICLE VI: PAYMENT PROCEDURES

- 6.1 The Contractor shall submit Contractor Payment Application. Payment Applications shall be processed by the City as provided in the General Conditions.
- 6.2 Progress Payments; The City shall make progress payments on account of the Contract Price on the basis of the Contractor's Payment Application on or about the twentieth (20th) day of each month during construction as provided in Paragraph 6.3 below. All such payments shall be measured by the schedule of value established in Section 01295 – Schedule of Values (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements.
- 6.3 Prior to Substantial Completion progress payments shall be made equal to the percentage of the Work completed, as established above, and materials and/or equipment not incorporated in the work completed but delivered, suitably stored, and accompanied by suitable documentation satisfactory to the City as provided in the General Conditions. Progress payments shall be made less retainage as indicated in Paragraph 6.4 and 6.5 below, but in each case, less the aggregate of payments previously made less such amounts as the City shall determine or withhold, in accordance with the General Conditions.
- 6.4 Retainage prior to Substantial Completion; If the total Contract Price at the time of Contract Execution is Five Hundred Thousand Dollars (\$500,000) or more, the agreed retainage until Substantial Completions shall be five percent (5%), otherwise the agreed retainage shall be ten percent (10%).
- 6.5 Retainage after Substantial Completion: On projects where a long period of time is expected to occur between the Substantial Completion and Final Acceptance, retainage shall be reduced by one-half (1/2). The reduced retainage shall never be less than the expected value of any work requiring correction or unfinished work. A portion of the retainage shall always be held until issuance of a Certification of Final Completion.

ARTICLE VII: INTEREST

- 7.1 All monies except retainage, not paid when due as provided in the General Conditions shall bear interest at the maximum rate allowed by the law.

ARTICLE VII: CONTRACTOR'S REPRESENTATIONS

In order to induce the City to enter into this Agreement the Contractor makes the following representations:

- 8.1 The Contractor has examined and carefully studied the Contract Documents (including the Addenda listed in Article IX) and other related data identified in the Documents including "technical data" and performed a constructability review.
- 8.2 The Contractor has visited the site and become familiar with and is satisfied as to the general local and site conditions, including utilities that may affect cost, progress, performance and furnishing of the Work.
- 8.3 The Contractor is familiar with and is satisfied as to all federal, state and local Laws and Regulations that may affect cost, progress, performance or furnishing of the Work.
- 8.4 The Contractor has carefully studied all reports of explorations and tests of subsurface conditions at or contiguous to the site and all drawings if physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in the General Conditions. Contractor accepts the determination set forth in the Supplementary Conditions of the extent of the "technical data" contained in such reports and drawings upon which the Contractor is entitled to rely as provided in the General Conditions. The Contractor acknowledges that such reports and drawings are not Contract Documents and may not be complete for the Contractor's purposes. The Contractor acknowledges that the City and the Design Professional shall not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Contract Documents with respect to Underground Facilities at or contiguous to the site. The Contractor has obtained and carefully studied (or assumes responsibility for having done so) all such additional supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the Work or which relate to any aspect of the means, methods, techniques, sequences and procedures of construction to be employed by the Contractor and safety precautions and programs incident hereto. The Contractor does not consider that any additional examinations, investigations, explorations, tests, studies or data are necessary for the performance and furnishing of the Work at the Contract Price, within the Contract Times and in accordance with other terms and conditions of the Contract Documents.

- 8.5 The Contractor is aware of the general nature of work to be performed by the City and others at the site that relates to the Work as indicated in the Contract Documents.
- 8.6 The Contractor has correlated the information known to the Contractor, information and observations obtained from visits to the site, reports and drawings identified in the Contract Documents and all examinations, investigations, explorations, tests, studies and data with the Contract Documents.
- 8.7 The Contractor has given the City written notice of all conflicts, errors, ambiguities or discrepancies that the Contractor has discovered in the Contract Documents and the written resolution thereof by the City is acceptable to the Contractor, and the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE IX: THE CONTRACT DOCUMENTS

The Contract Documents, which comprise the entire agreement between the FDEDC and the Contractor concerning the Work, consist of those referenced in this article. The Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all. In case of conflict between any of the Contract Documents, priority of interpretation shall be in the following order:

- 9.1 Any modification, including Change Orders, duly delivered after Execution of the Agreement
- 9.2 Addenda as issued, with Acknowledgement of Addenda if applicable
- 9.3 Federal Contract Required Clauses, including Certification for Contracts, Grants, Loans and Cooperative Agreements
- 9.4 Standard Agreement for Contracting Services (this agreement)
- 9.5 General Conditions.
- 9.6 Supplemental Conditions
- 9.7 Technical Specifications Divisions 1 through 16
- 9.8 Request for Proposals (Cover Sheet and numbered sheets)
- 9.9 Post-Bid Procedures
- 9.10 Insurance Requirements

- 9.11 Performance Bond, included herein
- 9.12 Payment Bond, included herein.
- 9.13 Texas Workers' Compensation
- 9.14 Wage Scale
- 9.15 Affidavit of Insurance, and Certificates of Insurance
- 9.16 Alcohol and Drug Free Workplace Policy
- 9.17 Construction Storm Preparation Policy
- 9.18 Hazardous Communications Program Requirement Agreement.
- 9.19 Homeland Security Policy
- 9.20 Child Support Affidavit
- 9.21 Unit Price Bid Form
- 9.22 Texas Ethics Commission Form 1295
- 9.23 Texas Government Code Verification

There are no Contract Documents other than those listed above in this Article IX. The Contract Documents shall only be altered, amended, or repealed by a modification (as defined in the General Conditions).

ARTICLE X: INDEMNIFICATION

CONTRACTOR SHALL PROTECT, DEFEND, INDEMNIFY, AND HOLD THE CITY, ITS OFFICERS, ELECTED OFFICIALS, AGENTS, AND EMPLOYEES, HARMLESS FROM ANY CLAIMS, FINES, DEMANDS, LOSS, DAMAGE, SUIT, AND LIABILITY OF EVERY KIND, INCLUDING ALL EXPENSES OF LITIGATION, COURT COSTS, AND ATTORNEY'S FEES, FOR INJURY TO OR DEATH OF ANY PERSON, OR FOR DAMAGE TO ANY PROPERTY, CAUSED BY THE NEGLIGENT, INTENTIONAL OR WILLFUL ACTS OR OMISSIONS OF THE CONTRACTOR, ITS OFFICERS, EMPLOYEES, AGENTS, CONTRACT LABORERS, OR SUBCONTRACTORS IN THE PERFORMANCE OF THIS AGREEMENT.

CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS OF ALL APPLICABLE LAWS, RULES, AND REGULATIONS IN CONNECTION WITH THE SERVICES OF CONTRACTOR AND SHALL EXONERATE, INDEMNIFY, DEFEND, AND HOLD HARMLESS THE CITY, ITS OFFICERS, AGENTS AND ALL EMPLOYEES FROM ANY AND ALL LIABILITY, LOSS OR DAMAGE ARISING OUT OF NONCOMPLIANCE WITH SUCH LAWS, RULES AND REGULATIONS, WITHOUT LIMITATION. CONTRACTOR SHALL ASSUME FULL RESPONSIBILITY FOR PAYMENTS OF FEDERAL, STATE AND LOCAL TAXES OR CONTRIBUTIONS IMPOSED OR REQUIRED UNDER THE SOCIAL SECURITY, WORKER'S COMPENSATION, AND INCOME TAX LAWS WITH RESPECT TO CONTRACTOR'S EMPLOYEES. FURTHER, CONTRACTOR SHALL EXONERATE, INDEMNIFY, DEFEND, AND HOLD HARMLESS THE CITY, ITS OFFICERS, AGENTS AND ALL EMPLOYEES FROM ANY AND ALL LIABILITY, LOSS, DAMAGES, EXPENSES OR CLAIMS ARISING OUT OF ANY ACT OR OMISSION, INTENTIONAL TORT, OR FAILURE TO PAY A SUBCONTRACTOR OR SUPPLIER OF CONTRACTOR, ITS OFFICERS, AGENTS AND EMPLOYEES IN CONNECTION WITH ANY OF THE WORK PERFORMED OR TO BE PERFORMED UNDER THIS CONTRACT BY CONTRACTOR OR AS A RESULT OF CONTRACTOR'S FAILURE TO USE AND EMPLOY REASONABLE SKILL AND CARE BEFITTING THE PROFESSION IN ACCORDANCE WITH THE TERMS OF THIS AGREEMENT. FURTHER, CONTRACTOR SHALL EXONERATE, INDEMNIFY, DEFEND, AND HOLD HARMLESS THE CITY, ITS OFFICERS, AGENTS, AND ALL EMPLOYEES FROM ANY AND ALL LIABILITY, LOSS, DAMAGES, EXPENSES OR CLAIMS FOR INFRINGEMENT OF ANY INTELLECTUAL PROPERTY ARISING OUT OF THE USE OF ANY PLANS, DESIGN, DRAWINGS, OR SPECIFICATIONS FURNISHED BY CONTRACTOR IN THE PERFORMANCE OF THIS AGREEMENT.

THE FOREGOING INDEMNIFICATION PROVISION SHALL APPLY TO CONTRACTOR REGARDLESS OF WHETHER OR NOT SAID LIABILITY, LOSS, DAMAGES, EXPENSES, OR CLAIMS IS CAUSED IN PART BY A PARTY INDEMNIFIED HEREUNDER.

THE CONTRACTOR SHALL REQUIRE ALL OF ITS APPROVED SUBCONTRACTORS TO INCLUDE IN THEIR SUBCONTRACTS, A RELEASE AND INDEMNITY IN FAVOR OF THE CITY IN

SUBSTANTIALLY THE SAME FORM AS ABOVE.

ARTICLE XI: MISCELLANEOUS

11.1 Terms used in this Agreement which are defined in the General Conditions will have the meanings indicated in the General Conditions.

11.2 Termination. In addition to the termination rights elsewhere in Contract Documents, the City may terminate this Agreement as follows:

a. For Convenience.

The performance of the work may be terminated at any time in whole or in part, by the City for its convenience. Any such termination shall be effected by delivery to the Contractor of a written notice (notice of termination) specifying the extent to which performance of the work is terminated and the date upon which termination becomes effective. If, for whatever reason, this contract is terminated for cause, which is later determined not to exist, the parties agree that the contract will be deemed to be terminated for convenience. In the event of termination for convenience, the Contractor shall only be paid its reimbursable costs incurred prior to the effective date of the termination notice and shall not be entitled to receive any further payment hereunder and shall be further subject to any claim the City may have against the Contractor under other provisions of this Contract or as a matter of law, including the refund of any overpayment of reimbursable costs and/or other payment.

b. For Cause.

Without prejudice to any other legal or equitable right or remedy that the City would otherwise possess hereunder or as a matter of law, the City, upon giving the Contractor ten (10) days' prior written notice, shall be entitled to terminate this Contract in its entirety at any time for the following:

- (1) If the Contractor becomes insolvent, commits any act of bankruptcy, makes a general assignment for the benefit of creditors, or becomes the subject of any proceeding commenced under any statute or law for the relief of debtors;
- (2) If a receiver, trustee or liquidator of any of the property or income of the Contractor shall be appointed;
- (3) If the Contractor shall fail to prosecute the work or any part thereof with diligence necessary to ensure its progress and completion as prescribed by the time schedules;
- (4) If within ten (10) calendar days after written notice thereof from the City or the City's Representative, the Contractor shall fail to remedy any defective work or work that does not conform to the requirements

of this Contract, specifications, and other Contract Documents, or any other default under any of the terms, provisions, conditions, or covenants contained in this Contract or any other current agreement between the Contractor and another City for similar construction work on other property; or

- (5) If the Contractor shall fail for any reason other than the failure by the City to make payment called upon when due.

In the event of such termination for cause, the Contractor shall only be paid its reimbursable costs incurred prior to the effective date of the termination and shall not be entitled to receive any further payment hereunder and shall be further subject to any claim that the City's Representative or the City may have against the Contractor under the provisions of this Contract or as a matter of law, including the refund of any overpayments of reimbursable costs or other payments.

c. Procedure after Notice of Termination.

After receipt of a notice of termination, whether with or without cause, the Contractor shall, in good faith and to the best of its ability, do all things necessary in light of such notice to assure the efficient and proper close-out of the terminated work (including, but not limited to, the protection of the City's property). Among other things the Contractor shall, except as otherwise directed or approved by the City, do the following:

- (1) Stop the work on the date and to the extent specified in the notice of termination;
- (2) Place no further orders or subcontracts for services, equipment, or material, except as may be necessary for completion of such portion of the work as is not terminated;
- (3) Immediately terminate all orders and subcontracts to the extent that they relate to the performance of the work terminated by the notice of termination;
- (4) Assign to the City, in the manner and to the extent directed by it, all of the right, title and interest of the Contractor under the orders or subcontracts so terminated in which case, the City shall have the right to settle or pay any or all claims arising out of the termination of such orders and subcontracts;
- (5) With the approval of the City, settle all outstanding liabilities and all claims arising out of such termination, orders and subcontracts;
- (6) Deliver to the City, when directed by the City, all documents and all property, which if the work had been completed, the Contractor would have been required to account for or deliver to the City, and transfer title to such property to the City to the extent not already transferred; and/or
- (7) Take actions necessary or as otherwise directed by the City's Representative or the City for the protection and preservation of the

work.

In the event of such termination, there shall be an equitable reduction of the Contract Price to reflect the reduction in the work. Costs incurred after the effective date of the notice of termination shall not be treated as reimbursable costs unless they relate to carrying out the unterminated portion or taking close-out measures, approved by the City.

- 11.3 No assignment by a party hereto of any rights under or interests in the Contract Documents shall be binding on another party hereto without written consent of the party sought to be bound; and specifically but without limitation, monies that may become due and monies that are due but may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment shall release or discharge the assignor from any duty or responsibility under the Contract Documents.
- 11.3 The City and the Contractor each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents.
- 11.4 Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon the City and the Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close to expressing the intention of the stricken provision.
- 11.5 Other Provisions – None.

ARTICLE XII: ADDRESSES FOR GIVING NOTICES

12.1 The City:

City of Friendswood
910 S. Friendswood Drive
Friendswood, Texas 77546

12.2 The Contractor:

[INSERT CONTRACTOR NAME]
[INSERT CONTRACTOR ADDRESS]
[INSERT CONTRACTOR CITY,STATE,ZIP]

ARTICLE XIII: VENUE

- 13.1 Any action brought by either party based on any claim arising under or as a result of this contract shall be brought in a court of competent jurisdiction in Galveston County, Texas.

EXECUTED IN on behalf of the Contractor by [INSERT CONTRACTOR REPRESENTATIVE] its [INSERT THEIR TITLE] shown below, and on behalf of the City by [INSERT MAYOR NAME], its Mayor, thereto duly authorized this [INSERT DAY] day of [INSERT MONTH], [INSERT YEAR].

ACCEPTED:

PROPOSED AND AGREED TO:

CITY:

CONTRACTOR:

CITY OF FRIENDSWOOD, TEXAS

[INSERT CONTRACTOR FIRM]

MAYOR

BY: _____
[INSERT TITLE]

DATE: _____

DATE: _____

ATTEST:

ATTEST:

CITY SECRETARY

(OFFICER OR SECRETARY)

APPROVED AS TO FORM:

CITY ATTORNEY

END OF SECTION

INTENT TO AWARD

Date: [INSERT DATE]

[INSERT CONTRACTOR NAME]
ATTN: [INSERT CONTRACTOR CONTACT]
[INSERT CONTRACTOR ADDRESS]
[INSERT CITY, STATE, ZIP]

RE: Project Name: Lift Station #2 Rehabilitation
Project No.: [INSERT PROJECT #]
CSP No.: 2026-03

Dear [INSERT CONTRACTOR CONTACT]:

Your [INSERT RFQ, RFP or BID] dated [INSERT DATE] for the above Contract has been considered and you are the apparent "Best Value" to the City. The [INSERT YOUR DEPARTMENT] of the City of Friendswood recommended that the City Council Award the [INSERT PROJECT NAME], [INSERT RFQ, RFP or BID] Number [INSERT RFQ, RFP or BID #], to [INSERT CONTRACTOR NAME] on [INSERT COUNCIL DATE]. The City Council approval and your satisfactory compliance with contractual requirements, the City hereby intends to award the construction contract to you for:

[INSTALL FULL AND COMPLETE PROJECT NAME]

The Contract Price is [INSERT WRITTEN DOLLAR AMOUNT] dollars and [INSERT WRITTEN CENTS] cents (\$[INSERT CONTRACT PRICE IN NUMBERS]) to be completed in the Contract Time of [INSERT WRITTEN CONTRACT TIME] ([INSERT TIME IN NUMBERS]) [INSERT Working OR Calendar] Days.

After the City Council has considered and approved this action, and after the City has signed the Documents, the City shall provide the Executed Contract as a PDF file.

Direct questions regarding the contract award process to [INSERT YOUR NAME] at [INSERT YOUR PHONE #].

Respectfully,

[INSERT YOUR NAME]
[INSERT YOUR TITLE]
City of Friendswood

END OF DOCUMENT

NOTICE TO PROCEED

Date: [INSERT DATE]

[INSERT CONTRACTOR NAME]
ATTN: [INSERT CONTRACTOR CONTACT]
[INSERT CONTRACTOR ADDRESS]
[INSERT CITY, STATE, ZIP]

RE: Project Name: [INSERT PROJECT NAME]
Project No.: [INSERT PROJECT #]
[INSERT RFQ, RFP or BID #]No.: [INSERT RFQ, RFP or BID #]

Dear [INSERT CONTRACTOR CONTACT]:

In accordance with the terms and conditions set out in the contract for the above referenced project and as directed by the City of Friendswood, you are herewith issued **Notice To Proceed** as of START DATE. According to our contract, the work of this project shall be substantially complete within [INSERT WRITTEN CONTRACT DAYS] ([INSERT # DAYS]) [INSERT Working OR Calendar] Days from the date of Notice To Proceed. Contract Time shall run as specified in the General Conditions. The work of this contract shall be complete on or before [INSERT COMPLETION DATE]. Final payment shall be made in accordance with the General Conditions.

Please contact the City of Friendswood [INSERT YOUR DEPARTMENT] forty-eight (48) hours prior to the start of construction. Additionally, you are responsible for informing property owners or residents of work schedules affecting access to and from their properties or any work that may impede or delay routine traffic routes. You are required to inform property owners or residents no less than twenty-four (24) hours prior to beginning any work within private property. Access to work within private property may require agreement with owners or other special provisions that you are responsible for obtaining.

Respectfully,

[INSERT YOUR NAME]
[INSERT YOUR TITLE]
City of Friendswood

END OF DOCUMENT

TEXAS WORKERS' COMPENSATION
In accordance with
28 TAC 110.110
DIVISION OF TEXAS WORKERS' COMPENSATION
TEXAS DEPARTMENT OF INSURANCE

A. DEFINITIONS

Certificate of coverage ("certificate") – A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84) showing statutory workers' compensation insurance coverage for the persons' or entity's employees providing services on a project, for the duration of the project.

Duration of the project – includes the time from the beginning of the work on the project until the Contractor's/person's work on the project has been completed and accepted by the governmental entity.

Persons providing services on the project ("subcontractor" in §406.096) – includes all persons or entities performing all or part of the services the Contractor has undertaken to perform on the project, regardless of whether that person contracted directly with the Contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the project. "Services" include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. "Services" does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

- B. The Contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all employees of the Contractor providing services on the project, for the duration of the project.
- C. The Contractor must provide a certificate of coverage to the City prior to being awarded the Contract.
- D. If the coverage period shown on the Contractor's current certificate of coverage ends during the duration of the project, the Contractor must, prior to the end of the coverage period, file a new certificate of coverage with the City showing that the coverage has been extended.

- E. The Contractor shall obtain from each person providing services on the project, and provide to the City:
 - 1. A certificate of coverage, prior to that person beginning work on the project, so the City will have on file certificates of coverage showing coverage for all persons providing services on the project; and
 - 2. No later than seven days (7 D) after the receipt by the Contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.
- F. The Contractor shall retain all required certificates of coverage on file for the duration of the project and for one year (1 Yr) thereafter.
- G. The Contractor shall notify the City in writing by certified mail or personal delivery, within ten days (10 D) after the Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project.
- H. The Contractor shall post on each project site a notice, in the text, form, and manner prescribed by the Texas Workers' Compensation Commission, informing all persons providing services on the project that they are required to be covered, and stating how a person may verify current coverage and report failure to provide coverage.
- I. The Contractor shall contractually require each person with whom it contracts to provide services on a project, to:
 - 1. Provide coverage, based on proper reporting classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code Section 401.011(44) for all employees providing services on the project, for the duration of the project;
 - 2. provide to the Contractor, prior to that person beginning work on the project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the project, for the duration of the project;
 - 3. provide the Contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;
 - 4. Obtain from each other person with whom it contracts, and provide to the Contractor:
 - (A) a certificate of coverage, prior to the other person beginning work on the project, and;
 - (B) a new certificate of coverage showing extension of the coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project;
 - 5. retain all required certificates of coverage on file for the duration of the project and for one year (1 Yr) thereafter;

6. notify the City in writing by certified mail or personal delivery, within ten days (10 D) after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project; and
 7. contractually require each other person with whom it contracts, to perform as required by paragraphs (1) – (7), with certificates of coverage to be provided to the person for whom they are providing services.
- J. By signing this Contract or providing or causing to be provided a certificate of coverage, the Contractor is representing to the City that all employees of the Contractor who will provide services on this project will be covered by workers' compensation coverage for the duration of the project, that the coverage will be based on proper reporting of classifications codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in case of a self-insured, with the commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the Contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.
- K. The Contractor's failure to comply with any of these provisions is a breach of contract by the Contractor which entitles the City to declare the contract void if the Contractor does not remedy this breach within ten days (10 D) after receipt of notice of breach from the City.

END OF SECTION

WAGE SCALE

PART I: GENERAL

- 1.1 As required by Chapter 2258, Subchapter A, Government Code, Building and Procurement Commission, Vernon's Texas Civil Statutes, the City has ascertained local prevailing wage rates for the type of any Civil or Utility work to be performed under the Contract.
- 1.2 The Amended Article further provides that the Contractor shall forfeit, as a penalty, to the City, Sixty dollars (\$60.00) per day for each laborer, workman, or mechanic who is not paid the stipulated wage for the type of work being performed by him as set up in the wage scale. The City is authorized to withhold from the Contractor the amount of this penalty in any payment that might be claimed by the Contractor or subcontractor. The Act makes the Contractor responsible for the acts of the subcontractors in this respect.
- 1.3 The Article likewise requires that the Contractor and subcontractors keep an accurate record of the names and occupations of all persons employed by him and to show the actual per diem wages paid to each worker and these records are open to the inspection of the City.
- 1.4 This prevailing wage rate does not prohibit the payment of more than the rates stated.
- 1.5 The hourly cost of salary for non-exempt workers for labor in excess of forty (40) hours per worker per week shall be calculated at one and one-half (1.5) times the worker's base pay.
- 1.6 The wage scale for engineering construction is to be applied to all site work greater than five (5) feet from an exterior wall of new building under construction or from an exterior wall of an existing building.

PART II: WAGE CLASSIFICATION

- 2.1 Refer to the sam.gov - This website provides the Davis-Bacon Act (DBA) wage determinations (WDs) for each official contract action. The website is available to the general public as well. Guidance in selecting WDs from this website is provided in the <https://sam.gov/content/home> Learning Center.

END OF DOCUMENT

AFFIDAVIT OF INSURANCE

BEFORE ME, the undersigned authority, on this day personally appeared [INSERT AFFIANT], who being by me duly sworn on their oath stated that [INSERT HE OR SHE] is [INSERT TITLE] of [INSERT CONTRACTOR NAME], a representative of the Contractor named and referred to within the Contract Documents; that they are fully competent and authorized to give this affidavit and that the attached original insurance certificate(s) truly and accurately reflects the insurance coverage that is now available and will be available during the term of the Contract.

(Affiant's Signature)

(Date)

SWORN AND SUBSCRIBED by me on this ____ day of _____,
A.D. 20_____.

Notary Public in and for _____ County, _____.

Notary Public Signature

NOTARY SEAL

Print or Type Notary Public Name

My Commission Expires: _____

END OF DOCUMENT

ALCOHOL AND DRUG FREE WORKPLACE

I. POLICY STATEMENT

In order to effectuate an alcohol and drug free workplace, the following general policy statements are hereby adopted:

- A. Employees shall not be permitted to report to work while under the influence of alcohol or drugs, or to possess or transfer drugs or alcohol to any person while on duty. Provided however, this policy statement shall not be construed to apply to members of the City Police Department or Emergency Medical Technicians when their duties require the lawful possession of seized of alcohol or drugs, or the transport thereof.
- B. Employees who are reasonably suspected of being under the influence of alcohol or drugs shall be prohibited from engaging in further work, and shall be subject to immediate testing in accordance with the procedures herein established.
- C. In recognition of serious duties and responsibilities entrusted to employees of the City and that use of alcohol or drugs hinder one's ability to perform and fulfill such duties and responsibilities, these policies are adopted to establish guidelines for the detection and deterrence of alcohol and drug abuse.
- D. When applying the policies contained herein, Management should always focus on the ability of the employee to prosecute his work. Tests and procedures outlined herein are only intended as tools to assist Management, not as a replacement of Management's responsibilities over employees in the performance of their duties.

II. PURPOSE OF POLICIES

The purpose of the alcohol and drug free workplace policies contained herein is as follows:

- A. To promote and maintain a safe, healthy, and productive work environment for all city employees.
- B. To ensure the safe and efficient delivery of services to the citizens of the city.
- C. To eliminate the abusive use of alcohol, illegal drugs, prescription drugs, or any other substance which could impair an employee's ability to perform safely and effectively the functions of any given job; and

- D. To establish compliance by the city with any and all state and federal rules and regulations relating to the establishment and maintenance of an alcohol and drug free workplace.

III. DEFINITIONS

For the purpose of these policies the following words, terms, and phrases shall have the meanings ascribed thereto:

- A. **“Alcohol”** means any beverage that contains ethyl alcohol (ethanol), including but not limited to, beer, wine and distilled spirits.
- B. **“Biological Testing”** or **“chemical testing”** or **“drug testing”** means the scientific analysis of urine, blood, breath, saliva, hair, tissue, and other specimens of the human body for the purpose of detecting alcohol or drugs.
- C. **“Chain of custody”** means procedures to account for the integrity of each urine specimen by tracking its handling and storage from point of specimen to collection to final disposition of the specimen. These procedures shall require that an approved chain of custody form be used from time to collection to receipt by the laboratory and that upon receipt of the laboratory an appropriate chain of custody form(s) account for the sample or sample aliquot within the laboratory. Chain of custody forms shall, at minimum, include an entry documenting date and purpose each time a specimen or aliquot is handled or transferred and identifying every individual in the chain of custody.
- D. **“Collection site”** means a place where individuals present themselves for the purpose of providing body fluids or tissue samples to be analyzed for specified controlled substances. A collection site will have all necessary personnel, materials, equipment, facilities and supervision to provide for collection, security, temporary storage, and transportation or shipment of the samples to a laboratory.
- E. **“Collection site person”** means a person who instructs and assists individuals as a collection site and who receives and makes initial examination of the specimens provided by those individuals. A collection site person shall have successfully completed training to carry out this function.
- F. **“Contract vendor”** means an independent testing or administrative agency engaged for the purpose of implementing one or more procedures in the collection or testing of employees for alcohol or drug use.
- G. **“City Premises”** or **“City Facilities”** means all property of the City including, but not limited to, buildings and surrounding areas on City-

owned or leased vehicles and equipment wherever located. It also includes premises where the city performs contract services.

- H. **“Confirmatory test”** means a second analytical procedure to identify the presence in urine specimen of a specific drug or metabolite which is independent of initial test and which uses a different technique and chemical principle from that of the initial test in order to ensure reliability and accuracy. Gas chromatography/mass spectrometry (GC/MS) is the only authorized confirmatory test method.
- I. **“Contraband”** means any article, the possession of which on City premises or while on City business,, causes as individual to be in violation of a City work rule. Contraband includes illegal drugs and alcohol beverages and drug paraphernalia.
- J. **“Controlled Substances”** means all substances listed in Schedule I through V of the Controlled Substances Abuse Act as those schedules may be revised from time to time.
- K. **“Drug”** means any substance that is a controlled substance.
- L. **“Employee”** means an employee, contractor, subcontractor, agent, officer, or representative of the City.
- M. **“Illegal Drug”** means any drug which is not legally obtainable; any drug which is legally obtainable but has not been legally obtained; any prescribed drug not being used for the prescribed purpose; and over-the-counter drug being used at a dosage level different than recommended by the manufacturer or being used for a purpose other than intended by the manufacturer or being used for a purpose not in accordance with bona fide medical therapy. Examples of illegal drugs are Cannabis substance such as marijuana and hashish, cocaine, heroin, phencyclidine (PCP), and so –called designer drugs and look-alike drugs.
- N. **“Initial test”** or **“screening test”** or **“preliminary test”** means in the context of drug detection an immunoassay screen to eliminate negative uria specimens from further consideration. In the context of alcohol detection, these terms mean an analysis of breath or saliva specimens for the purpose of eliminating negative specimens from further consideration.
- O. **“Legal drug”** means any prescribed drug or over-the-counter drug, which has been legally obtained and is being used for the purpose of which prescribed or manufactured.
- P. **“Medical practitioner”** means a licensed physician.
- Q. **“Under the Influence”** means any detectable trace or amount.

**CONTRACTOR'S CERTIFICATION FOR COMPLIANCE TO
THE CITY OF FRIENDSWOOD
ALCOHOL AND DRUG FREE WORKPLACE POLICIES**

This is to certify that the officers and operating management of [INSERT CONTRACTOR NAME] have read and acknowledge understanding of and agreement with the provisions of the City of Friendswood, Texas Alcohol and Drug Free Workplace policies, and the implementing procedures related thereto.

This certification confirms our obligation to comply with the above-named policies and we further acknowledge and agree that our failure to comply with the provisions thereof shall constitute a material breach of that certain Contract dated [INSERT MONTH] [INSERT DATE], [INSERT YEAR] by and between the aforescribed and the City of Friendswood, Texas.

[INSERT CONTACT NAME]
[INSERT CONTACT TITLE]

Date

END OF DOCUMENT

CONSTRUCTION STORM PREPARATION POLICY

PART I: GENERAL

- 1.1 The City of Friendswood has instituted a storm preparation policy to help protect citizens and property from damage due to loose construction materials driven by storm winds. Storms covered by this policy may be tropical disturbances, hurricanes, and systems of disturbed weather associated with weather front movements.
- 1.2 Storms from the Gulf of Mexico and systems of disturbed weather associated with fronts are preceded by a warning system from the National Weather Service that allows some time to prepare.

PART II: DEFINITIONS

2.1 WATCH

- A. A National Weather Service notice indicating that a particular hazard is possible, i.e., that conditions are more favorable than usual for its occurrence. A watch is a recommendation for planning, preparation, and increased awareness (i.e., to be alert for changing weather, listen for further information, and think about what to do if the danger materializes).

2.2 WARNING

- A. A notice issued by the National Weather Service local offices indicating that a particular weather hazard is either imminent or has been reported. A warning indicates the need to take action to protect life and property. The type of hazard is reflected in the type of warning (e.g., tornado warning, hurricane warning, etc.)

2.3 GALE AND STORM WARNINGS

- A. Gale warning may be issued when winds of 39-54 miles an hour (34-47 knots) are expected. Storm Warnings may be issued when winds of 55-73 miles an hour (48-63 knots) are expected. If a hurricane is expected to strike a coastal area, gale or storm warnings will not usually precede hurricane warnings.

2.4 HURRICANE ADVISORY

- A. A notice issued by the National Hurricane Center, numbered consecutively for each storm, describing the present and forecasted position and intensity. Advisories are issued at six (6) hour intervals at midnight, 6 a.m., noon, and 6 p.m., Eastern Daylight Time. Bulletins provide additional information. Each message gives the name, eye position, and intensity and forecast movement of the storm.

2.5 HURRICANE WATCH

- A. An announcement added to a hurricane advisory that hurricane conditions pose a possible threat to a specified coastal area within thirty-six (36) hours. A watch is used to inform the public and marine interests of the storms location and intensity, and movement.

2.6 HURRICANE WARNING

- A. A warning added to a hurricane advisory that sustained winds of 74 mph (64 knots) or higher associated with a hurricane are expected in a specified coastal area within twenty-four (24) hours or less. A hurricane warning can remain in effect when dangerously high water or a combination of dangerously high water and exceptionally high waves continue, even though winds may be less than hurricane force. A warning is issued to inform the public and marine interest of the storms location, intensity, and movement. The NHC chooses a distance of approximately 300 miles.

2.7 SEVERE THUNDERSTORM WATCH

- A. A notice that severe thunderstorms are possible in your area.

2.8 SEVERE THUNDERSTORM WARNING

- A. A notice that severe thunderstorms are occurring.

PART III: EXECUTION

3.1 PHASE 1 – ALERT/WATCH PHASE

- A. This phase shall go into affect with a call and Fax from the City of Friendswood to the Contractor. The Contractor's superintendent on site shall also be informed and the Project Manager shall go over the steps that shall to be taken. This shall be initiated when The National Weather Service issues a watch or warning indicating a Gulf storm system or a severe weather front exists and poses a "potential" threat to the Friendswood area.
- B. The following actions shall be taken during an Alert/Watch Phase:
 - 1. The Contractor shall immediately undertake cleanup operations at the job site.
 - 2. Make preparations to remove all debris and trash from the site.
 - 3. Stack and secure other materials that are subject to wind movement.
 - 4. Make preparations to back-fill all excavations and secure all equipment.
 - 5. Secure all facilities such as trailers, port-a-cans, tool sheds, etc.
 - 6. Doors and windows are to be closed and locked.

3.2 Phase 2 – Threat / Warning Phase

- A. When Friendswood is within the predicted impact area as in the path of a severe weather front, or in the path of a hurricane, additional

preparation must be made. Phase Two (2) shall go into affect with a second (2nd) call from the City of Friendswood to the contractor.

- B. The following action shall be taken during a Threat/Warning Phase:
1. The Contractor shall immediately suspend ALL building operations.
 2. All materials shall be tied down to resist the reported National Weather Service probable winds. Always assume the worst-case wind.
 3. Any materials that are not tied down shall be stored in heavy containers or carried off the job site.
 4. If structures are partly finished, storm bracing shall be added to withstand the probable storm winds.
 5. All windows are shall protected from flying debris and wind damage.
 6. All equipment shall be stored or removed from the job site to a safe place.
 7. Trailers, port-a-cans, and any other facilities shall be tied down.
 8. All excavations shall be covered.
 9. All incomplete work shall be stabilized.
 10. Take necessary precautions against rising water – some sites may be in flood prone areas.

3.3 TRAFFIC CONTROL DEVICES

- A. All Traffic Control devices for the project shall be in place and in good condition. Traffic Control Devices are **NOT** to be secured or extra weight added to hold them in place. Traffic Control Devices are to remain as originally placed and within the guidelines of the TMUTCD.
- B. All Traffic Control signage shall be cleaned for visibility, and if not up to current TMUTCD standards shall be replaced.

3.4 NOTIFICATION CONTACTS

- A. Each Contractor shall provide and maintain a contact name and two Alternates with day and night telephone numbers to The City of Friendswood for these emergency notifications.

This is to certify that the officers and operating management of [INSERT CONTRACTOR NAME] have read and acknowledge understanding of and agreement with the provisions of the City of Friendswood, Storm Policy, and the implementing procedures related thereto. The emergency contacts listed below have been given copies of this policy and instructed in the procedures contained herein.

This certification confirms our obligation to comply with the above-named policies and we further acknowledge and agree that our failure to comply with the provisions thereof shall constitute a material breach of that certain Contract dated [INSERT MONTH] [INSERT DATE], [INSERT YEAR] by and between the aforescribed and the City of Friendswood, Texas.

Signature

Print Name

Company Name

COMPANY CONTACTS:

Contact #1 Name

Contact #2 Name

Daytime Phone Number

Daytime Phone Number

Nighttime Phone Number

Nighttime Phone Number

Contact #3 Name

Daytime Phone Number

Nighttime Phone Number

CITY OF FRIENDSWOOD CONTACTS:

Contact #1 Name

[INSERT DIRECTOR NAME]
Director of [INSERT DEPARTMENT]
(281) [INSERT YOUR NUMBER]
Daytime Phone Number

Contact #2 Name

[INSERT SUPERVISOR NAME]
[INSERT TITLE]
(281) [INSERT YOUR NUMBER]
Daytime Phone Number

Contact #3 Name

[INSERT YOUR NAME]
[INSERT YOUR TITLE]
(281) [INSERT YOUR NUMBER]
Daytime Phone Number

Any nighttime contact will be made via Police Department Dispatch at (281) 996-3300.

END OF DOCUMENT

**HAZARDOUS COMMUNICATIONS PROGRAM
REQUIREMENT AGREEMENT
For Contractors Performing Work Under Contract**

PART I: GENERAL

Whereas, the City of Friendswood desires to comply with the Texas Hazard Communications Act of the Health and Safety Code, provide and maintain a safe and healthy work environment for its employees, citizens and contractors and to provide for the free access to and communication of information pertaining to the use and storage of materials in the workplace; and

Whereas, the City of Friendswood wants to ensure that its contractors do the same.

Accordingly, the City of Friendswood's Hazard Communications Program maintains a list of all materials stored or used within its sites and facilities. Additionally, the City maintains and updates its inventories of MSDS on a routine basis so as to provide its employees, citizens and contractors with the most accurate and up-to-date information pertaining to materials that an employee or contractor might come into contact with during the course of normal operations.

The City acknowledges its obligations under these States and federal laws to make any and all such information available to the contractor, his employees, vendors and sub-contractors for sites or facilities within which its contractors, their employees, vendors and sub-contractors are engaged in work.

It is hereby understood and agreed that [INSERT CONTRACTOR NAME], performing the work of the contract for [INSERT PROJECT NAME], shall provide and maintain, within the limits of all applicable laws, a satisfactory job-site Hazard Communications program including, but not limited to, an Employer Right to Know information center, which shall have a Hazard Communication Information Binder for all chemicals, materials and substances that are required for, used, stored, or incorporated into the work of the contract and a Workplace chemical list.

The Contractor shall retain all legal responsibility for providing and maintaining this center and providing accurate and an up-to-date list of all such materials chemicals and substances and the appropriate Material Safety Data Sheets (MSDS) throughout the duration of the contract or as long as the Contractor's forces, materials, substances or chemicals remain or continue to be stored on site.

The Contractor further agrees to notify the City's representative in advance if any of the work requires the use of or storage of any "hazardous chemical."

The terms and conditions of this agreement shall remain a part of the Contract and in force whether attached to the Contract or not.

PART II: DEFINITIONS

- 2.1 "Contractor"
- A. Any entity legally contracted with the City of Friendswood for the purpose of providing services or goods of any nature in exchange for monetary consideration.
- 2.2 "Duration of Contract"
- A. The agreed contract time as defined and amended by the terms of the agreement.
- 2.3 "Employee vendor and sub-contractor"
- A. Means a person or group who may be or may have been exposed to hazardous chemicals in the person's workplace under normal operating conditions or foreseeable emergencies, and includes a person working for this state, a person working for a political subdivision of this state, or a member of a volunteer emergency service organization
- 2.4 "Hazardous chemical" or "chemical"
- A. Means an element, compound, or mixture of elements or compounds that is a physical hazard or health hazard as defined by the OSHA standard in 29 CFR Section 1910.1200(c), or a hazardous substance as defined by the OSHA standard in 29 CFR Section 1910.1200(d)(3), or by OSHA's written interpretations. A hazard determination may be made by employers who choose not to rely on the evaluations made by their suppliers if there are relevant qualitative or quantitative differences. Hazard determination shall involve professional judgment.
- 2.5 "Material Safety Data Sheet" ("MSDS")
- A. Means a document containing chemical hazard and safe handling information that is prepared in accordance with the requirements of the OSHA standard for that document.
- 2.6 "Workplace chemical list"
- A. Means a list of hazardous chemicals developed under Section 502.005(a) of the Texas Health and Safety Code.

This certification confirms our obligation to comply with the above-named policies and we further acknowledge and agree that our failure to comply with the provisions thereof shall constitute a material breach of that certain Contract dated [INSERT DATE] by and between the aforescribed and the City of Friendswood, Texas.

[INSERT CONTACT NAME]
[INSERT CONTACT TITLE]

Date

END OF DOCUMENT

00270-2

HOMELAND SECURITY POLICY

On October 8, 2001 the President of the United States established the Department of Homeland Security. The Department of Homeland Security implemented the National Strategy for Homeland Security on October 8, 2002. Providing Homeland Security for potable water systems is a federally mandated requirement for Owner/Operators of public water systems as evidenced in Homeland Security Presidential Directive HSPD-7 on December 17, 2003. The City of Friendswood has accepted this responsibility to protect the potable water system that serves its customers.

The responsibility to maintain a secure site falls upon the Contractors working at or on water system improvements. Unfortunately this responsibility has not always been accepted and maintained by the City's Contractors.

The City is very serious about its responsibilities to protect the potable water system. Contractors that do not maintain secure sites, per instructions from the City, shall be subject to financial and civil legal action provided by the Contract and the Judicial System. Contractors that repeatedly fail to maintain a secure site may be locked out of the site until they comply with all the requirements of securing the site.

The City has the right to have security provisions implemented and to deduct said cost from the Contract as a last resort.

For the purpose of this document the meaning of secure is as follows: Reducing the vulnerability of critical infrastructure or key resources in order to deter, mitigate or neutralize terrorist attacks.

At a minimum the contractor shall enclose such areas with a fence and padlock so that access to such areas is not easily accomplished.

This certification confirms our obligation to comply with the above-named policies and we further acknowledge and agree that our failure to comply with the provisions thereof shall constitute a material breach of that certain Contract dated [INSERT MONTH] [INSERT DATE], [INSERT YEAR] by and between the aforescribed and the City of Friendswood, Texas.

[CONTRACTOR CONTACT NAME]
[INSERT CONTACT TITLE]

Date

END OF DOCUMENT

CERTIFICATE OF INTERESTED PARTIES (Form 1295)

In 2015, the Texas Legislature adopted [House Bill 1295](#). The Texas Government Code §2252.908, and the rules issued by the Texas Ethics Commission found in Title 1, Sections 46.1, 46.3 and 46.5 of the Texas Administrative Code, require a business entity to submit a completed Form 1295 to the City before the City may enter into a contract with that business entity. The law states that a governmental entity or state agency may not enter into certain contracts with a business entity unless the business entity submits a disclosure of interested parties to the governmental entity or state agency at the time the business entity submits the signed contract to the governmental entity or state agency. **The law applies only to a contract of a governmental entity or state agency that either (1) requires an action or vote by the governing body of the entity or agency before the contract may be signed or (2) has a value of at least \$1 million. The disclosure requirement applies to a contract entered into on or after January 1, 2016.**

Form 1295 must be completed online. The form is available from the Texas Ethics Commission by accessing the following web address:

<https://www.ethics.state.tx.us/filinginfo/1295/>

Print the completed Form 1295 showing the Certification Number and Date Filed in the Certification of Filing box at the upper right corner. The person filing the 1295 needs to complete an “unsworn declaration”.

The following definitions found in the statute and Texas Ethics Commission rules may be helpful in completing Form 1295.

“Business entity” includes an entity through which business is conducted with a governmental entity or state agency, regardless of whether the entity is a for-profit or nonprofit entity. The term does not include a governmental entity or state agency.

“Controlling interest” means: (1) an ownership interest or participating interest in a business entity by virtue of units, percentage, shares, stock, or otherwise that exceeds 10 percent; (2) membership on the board of directors or other governing body of a business entity of which the board or other governing body is composed of not more than 10 members; or (3) serves as an officer of a business entity that has four or fewer officers, or service as one of the four officers most highly compensated by a business entity that has more than four officers.

“Interested party” means: (1) a person who has a controlling interest in a business entity with whom a governmental entity or state agency contracts; or (2) a person who actively participates in facilitating a contract or negotiating the terms of a contract with a governmental entity or state agency, including a broker, intermediary, adviser, or attorney for the business entity. Subsection (c) of this section does not apply to an officer of a publicly held business entity or its wholly owned subsidiaries.

“Intermediary”, for purposes of this rule, means a person who actively participates in the facilitation of the contract or negotiating the contract, including a broker, adviser, attorney, or representative of or agent for the business entity who:

- (1) receives compensation from the business entity for the person’s participation;
- (2) communicates directly with the governmental entity or state agency on behalf of the business entity regarding the contract; and
- (3) is not an employee of the business entity.

The law has been amended beginning January 1, 2018. A completed Form 1295 is not required for:

- A sponsored research contract of an institution of higher education;
- An interagency contract of a state agency or an institution of higher education
- A contract related to health and human services if:
 - The value of the contract cannot be determined at the time the contract is executed; and
 - Any qualified vendor is eligible for the contract;
- A contract with a publicly traded business entity, including a wholly owned subsidiary of the business entity
- A contract with an electric utility, as that term is defined by Section 31.002, Utilities Code; or
- A contract with a gas utility, as that term is defined by Section 121.001, Utilities Code.



City of Friendswood

TEXAS GOVERNMENT CODE VERIFICATIONS

(for Companies with 10 or more full-time employees entering into a contract with a value of \$100,000 or more)

Pursuant to the Texas Government Code, I, _____, the undersigned representative of _____ (Company Name), do hereby verify the following for and on behalf of the above-referenced company (the "Company"):

- a. the Company does not boycott Israel and will not boycott Israel during the term of the contract to be entered into with the City of Friendswood;
- b. the Company does not boycott energy companies and will not boycott energy companies during the term of the contract to be entered into with the City of Friendswood; and
- c. the Company does not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association and will not discriminate during the term of the contract against a firearm entity or firearm trade association.

In making this verification, I understand that the following definitions apply:

1. "Boycott Israel" means refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations specifically with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory, but does not include an action made for ordinary business purposes.
2. "Boycott energy company" means, without an ordinary business purpose, refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations with a company because the company:
 - a. engages in the exploration, production, utilization, transportation, sale, or manufacturing of fossil fuel-based energy and does not commit or pledge to meet environmental standards beyond applicable federal and state law; or
 - b. does business with a company described by Paragraph (a).
3. "Discriminate against a firearm entity or firearm trade association" means, with respect to the entity or association, to:
 - a. refuse to engage in the trade of any goods or services with the entity or association based solely on its status as a firearm entity or firearm trade association;
 - b. refrain from continuing an existing business relationship with the entity or association based solely on its status as a firearm entity or firearm trade association; or
 - c. terminate an existing business relationship with the entity or association based solely on its status as a firearm entity or firearm trade association;but does not include:
 - a. the established policies of a merchant, retail seller, or platform that restrict or prohibit the listing or selling of ammunition, firearms, or firearm accessories; and
 - b. a company's refusal to engage in the trade of any goods or services, decision to refrain from continuing an existing business relationship, or decision to terminate an existing business relationship:
 - (1) to comply with federal, state, or local law, policy, or regulations or a directive by a regulatory agency; or
 - (2) for any traditional business reason that is specific to the customer or potential customer and not based solely on an entity's or association's status as a firearm entity or firearm trade association.

EXECUTED this the _____ day of _____, 20_____.

Company Name

Signature

Printed Name/Title

STATE OF TEXAS §
COUNTY OF HARRIS §

Before me, _____, the undersigned notary public, on this day personally appeared _____, the _____ (Title) of _____ (Company Name), known to me to be the person whose name is subscribed to the foregoing instrument, who after by me being duly sworn, did swear and affirm that the above is true and correct.

Given under my hand and seal of office this _____ day of _____, 20_____.

Notary Public in and for the State of Texas

PERFORMANCE BOND

Bond Number: [INSERT BOND #]

THAT WE, [INSERT CONTRACTOR NAME], as Principal, hereinafter called Contractor, and the other subscriber hereto, [INSERT SURETY NAME], as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Friendswood, a municipal corporation, in the sum of [INSERT WRITTEN DOLLAR AMOUNT] dollars and [INSERT WRITTEN CENTS AMOUNT] cents (\$[INSERT AMOUNT IN #'S]), for the payment of which sum well and truly to be made to the City of Friendswood and its successors, the said Contractor and Surety do bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a contract in writing with the City of Friendswood for Lift Station No. 2 Rehabilitation, all of such work to be done as set out in full in said Contract documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein;

NOW, THEREFORE, if the said Contractor shall faithfully and strictly perform the Contract in all its terms, provisions, and stipulations in accordance with its true meaning and effect, and in accordance with the Contract Documents referred to therein and shall comply strictly with each and every provision of the Contract and this Bond, then this obligation shall become null and void and shall have no further force and effect; otherwise the same is to remain in full force and effect. Should the Contractor fail to faithfully and strictly perform the Contract in all its terms, including but not limited to the indemnifications thereunder, the Surety shall be liable for all damages, losses, expenses, and liabilities that the City may suffer in consequence thereof, as more fully set forth herein.

IT IS FURTHER PROVIDED herein that pursuant to this undertaking, the Principal hereof and the Surety shall both be bound until date of final completion as shall be expressed and set out in the terms and conditions of the Contract, and suit on said bond may be brought up until the first anniversary of the date of said final completion, or abandonment or termination of the public work contract as is provided for in Chapter 2253.078(a), Texas Government Code, as may be amended.

It is further understood and agreed that the Surety does hereby relieve the City or its representatives from the exercise of any diligence whatever securing compliance on the part of the Contractor with the terms of the Contract, and Surety agrees that it shall be bound to take notice of and shall be held to have knowledge of all acts or omissions of the Contractor in all matters pertaining to the Contract. The Surety understands and agrees that the provision in the Contract that the City shall retain certain amounts due the Contractor until the expiration of thirty (30) days from the acceptance of the Work, which is intended for the City's benefit, and the City shall have the right to pay or

withhold such retained amounts or any other amount owing under the Contract without changing or affecting the liability of the Surety hereon in any degree.

It is further expressly agreed by the Surety that the City or its representatives are at liberty at any time, without notice to the Surety, to make any changes in the Contract Documents and in the Work to be done there under, as provided in the Contract and in the terms and conditions thereof, or to make any extension of time, any change in, addition to, or deduction from the Work to be done thereunder, and that such changes, if made, shall not in any way vitiate the obligation in this bond and undertaking or release the Surety therefrom.

It is further expressly agreed and understood that the Contractor and Surety will full indemnify, defend, and save harmless the City from any liability, loss, cost, expense, or damage arising out of the Contractor's performance of the Contract.

If the City gives the Surety notice of the Contractor's default, Surety shall, within forty-five (45) days take one (1) of the following actions:

1. Arrange for the Contractor, with consent of the City, to perform and complete the Contract; or
2. Take over and assume the completion of the Contract itself, through its agents or through independent contractors, and become entitled to the payment of the balance of the Contract Price.

If the Surety fails to take either of the actions set out above, it shall be deemed to have waived its right to perform and complete the Contract and receive payment of the balance of the Contract Price and the City shall be entitled to enforce and remedies available at law, including but not limited to completing the Contract itself and recovering any cost in excess of the Original Contract Price from the Surety.

This Bond and all obligations created hereunder shall be performable in Galveston County, Texas. This Bond is given in compliance with the provisions of Chapter 2253, Texas Government Code, as amended, which is incorporated herein by this reference.

Notices required or permitted hereunder shall be given in writing and shall be deemed delivered when actually received or, if earlier, on the third (3rd) day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other Party at the address prescribed in the Contract Documents or at such other address as the receiving party may hereafter prescribe by written notice to the sending party.

IN WITNESS THEREOF, the Bidder and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

ATTEST SEAL:

[INSERT CONTRACTOR NAME]

Name of Contractor

Signature

Name: [INSERT NAME]

Title: [INSERT TITLE]

ATTEST SEAL:

[INSERT SURETY NAME]

Full Name of Surety

[INSERT SURETY ADDRESS]

Address of Surety for Notice

[INSERT CITY, STATE, ZIP]

City, State and Zip Code of Surety for Notice

[INSERT SURETY TEL #]

Telephone Number of Surety

Signature

Name: [INSERT NAME]

Title: Attorney-in-Fact

Date: _____

END OF DOCUMENT

PAYMENT BOND

Bond Number: [INSERT BOND #]

THAT WE, [INSERT CONTRACTOR NAME], as Principal, hereinafter called Contractor, and the other subscriber hereto, [INSERT SURETY NAME], as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Friendswood, a municipal corporation, in the sum of [INSERT WRITTEN DOLLAR AMOUNT] dollars and [INSERT WRITTEN CENTS AMOUNT] cents (\$[INSERT AMOUNT IN #'S]), for the payment of which sum well and truly to be made to the City of Friendswood and its successors, the said Contractor and Surety do bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a contract in writing with the City of Friendswood for Lift Station No.2 Rehabilitation, all of such work to be done as set out in full in said Contract documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein;

NOW, THEREFORE, if the said Contractor shall pay all claimants supplying labor and materials to him or a Subcontractor in the prosecution of the Work provided for in the Contract, then, this obligation shall be void and shall no further force and affect; otherwise the same is to remain in full force and effect;

This Bond and all obligations created hereunder shall be performable in Galveston County, Texas. This Bond is given in compliance with the provisions of Chapter 2253, Texas Government Code, as amended, which is incorporated herein by this reference.

Notices required or permitted hereunder shall be given in writing and shall be deemed delivered when actually received or, if earlier, on the third (3rd) day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other Party at the address prescribed in the Contract Documents or at such other address as the receiving party may hereafter prescribe by written notice to the sending party.

IN WITNESS THEREOF, the Bidder and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

ATTEST SEAL:

[INSERT CONTRACTOR NAME]

Name of Contractor

Signature

Name: [INSERT NAME]

Title: [INSERT TITLE]

ATTEST SEAL:

[INSERT SURETY NAME]

Full Name of Surety

[INSERT SURETY ADDRESS]

Address of Surety for Notice

[INSERT CITY, STATE, ZIP]

City, State and Zip Code of Surety for Notice

[INSERT SURETY TEL #]

Telephone Number of Surety

Signature

Name: [INSERT NAME]

Title: Attorney-in-Fact

Date: _____

END OF DOCUMENT

GENERAL CONDITIONS

INDEX

Title	Paragraph
<u>City of Friendswood</u>	
Indemnification.....	71
Inspection	54
Interest of Local Public Officials.....	11
Interest of Members of the City.....	12
Land and Rights-Of-Way	32
Notice and Service Thereof	33
Use and Occupancy Prior to Acceptance by the City	29
Use of Premises and Removal of Debris.....	30
<u>Claims</u>	
Antitrust.....	74
Changes In Work	49
Claims for Extra Cost.....	48
Delay, Disruption, or Other Claims	75
Delays.....	72
Extras.....	50
Subsurface Conditions.....	47
Time For Completion and Liquidated Damages	51
Weather Conditions	52
<u>Contract</u>	
Acceptance of Final Payment Constitutes Release.....	42
Additional or Substitute Bond	39
Agreement and Contract Document	1
Assignments	40
Contract Security	38
Definitions	2
Maintenance of Work.....	73
Quantities of Estimate.....	31
Suspension of Work.....	27
Termination of Contract for Cause.....	3
<u>Contractor</u>	
Certificates and Permits.....	14
Compliance with Laws	9
Construction Schedule and Periodic Estimates.....	44
Contractors Obligations	24
Copyright	8
Findings Confidential	7
Guarantee of Work	15
Incorporation of Provisions Required by Law	13
<u>Contractor (cont.)</u>	
Insurance	25
Interest of Contractor and Employees	12
Mutual Responsibility of the Contractors	41

Patents.....	22
Payment by Contractor	43
Payments to Contractor	45
Personnel.....	4
Protection of the Work and Property – Emergency	53
Records and Audits	6
Reports and Information	5
Sanitary and Safety Facilities	76
Separate Contract.....	34
Subcontracting.....	35
Submittals	77
Superintendence by Contractor	55
Surveys.....	23
Warranties	78
<u>Design Professional</u>	
Meaning and Intent	37
The City’s Design Professional Authority.....	36
<u>Laws and Regulations</u>	
Breach of Federal Labor Standards Provisions	68
Civil Rights Act of 1964.....	70
Claims and Disputes Pertaining to Wage Rates.....	63
Complaints, Proceedings, or Testimony by Employees	62
Employment of Certain Persons Prohibited.....	58
Employment of Laborers or Mechanics not listed in aforesaid Wage Determination Decision	59
Equal Opportunity Provisions – E.O. 11246	69
Federal Labor Standards Provisions	56
Fringe Benefits not Expressed as Hourly Wage Rates.....	60
Ineligible Subcontractors	66
Payroll and Basic Payroll Records of the Contractor and the Subcontractor	64
Posting Wage Determination Decisions and Authorized Wage Deductions.....	61
Provisions to be Included in Certain Subcontracts	67
Safety and Health Regulations for Construction.....	28
Special Conditions Pertaining to Hazards, Safety Standards, and Accident Prevention.....	26
Specific Coverage of Certain Types of Work by Employees	65
Underpayment of Wages or Salaries.....	57
<u>The Work</u>	
Additional Instructions and Detail Drawings	16
Contractor’s Title to Materials	19
Correction of Work.....	46
Inspection and Testing of Materials	20
Materials, Services, and Facilities	18
“Or Equal” Clause	21

1. THE AGREEMENT AND THE CONTRACT DOCUMENTS

The Drawings, Technical Specifications and Addenda, enumerated in the Agreement, shall form part of this Contract and the provisions thereof shall be as binding upon the parties hereto as if they were herein fully set forth. The table of contents, titles, headings, running headlines and marginal notes contained herein and in said Documents are solely to facilitate reference to various provisions of the Contract Documents and in no way affect, limit, or cast light on the interpretation of the provisions to which they refer.

2. DEFINITIONS

The following terms, as used in this Contract, are respectively defined as the following:

- A. "ADDENDA": Written or graphic instrument issued prior to Bid opening, which clarifies, modifies, corrects, or changes the Bid Documents.
- B. "ALTERNATE": The total amount bid for additions to the Work. Each Alternate includes cost of effects on adjacent or related components, and Bidder's overhead and profit.
- C. "APPARENT LOW BIDDER": The bidder at the time of the bid opening who has the lowest documented bid before tabulation of the Bid Form.
- D. "BID": A complete and properly signed offer or proposal on the Unit Price Form or Total Stipulated Price Form, setting forth price for the Work that shall be performed.
- E. "BID DATE": The date and time set for receipt of Bids
- F. "BID DOCUMENTS": The Project Manual, the Drawings, and Addenda.
- G. "BIDDER": The person or firm who submits a Bid to the City.
- H. "CHANGE ORDER": A document which is signed by the Contractor and the City which authorizes an addition, deletion, or revision to the Work or an adjustment of the Contract Price or the Contract Time.
- I. "CITY": The City of Friendswood, Texas.
- J. "CODE": The City of Friendswood Code of Ordinances (CFCO).
- K. "CONSTRUCTABILITY REVIEW": A review and analysis by a Construction Professional of the Contract Documents and Drawings to report any errors, omissions, or inconsistencies that would prevent the project from being constructed according to the Contract Documents and Drawings.
- L. "CONTRACT DOCUMENTS": Those documents so designated as the City's Standard Agreement.
- M. "CONTRACT PRICE": The monies payable by the City to the Contractor for Final Completion of the Work in accordance with the City's Standard Agreement.
- N. "CONTRACT TIME": The number of Working Days to achieve Substantial and/or Final Completion as stated in the City's Standard Agreement.
- O. "CONTRACTOR": A person, firm, or corporation with whom the Contract is made with the City.
- P. "DESIGN PROFESSIONAL": The individual or entity, either Engineer or Architect, with whom the City contracted for design and construction of the Work and named as such in the City's Standard Agreement.
- Q. "DRAWINGS": The part of the Contract Documents prepared and/or

- approved and sealed by the Engineer which graphically shows the scope, extent, and character of the Work to be performed.
- R. "FINAL COMPLETION": The time at which all punch list items, start up procedures and other Closeout functions have been completed by the Contractor and verified by the Project Manager and recommends Final Acceptance of the Work to the City Council, and to release the Final Payment to the Contractor.
 - S. "LOW BIDDER": The Bidder that submits a Bid with lowest Total Bid Price and has been verified by Bid Tabulation.
 - T. "PROJECT MANAGER": The person designated by the City to represent the City during bidding, post-bid, and construction periods.
 - U. "PROJECT MANUAL": A volume assembled for the Work that includes the bidding requirements, sample forms, the Conditions of the Contract, and the Technical Specifications.
 - V. "SECURITY DEPOSIT": A certified check, cashier's check, or bid bond in the amount of five percent (5%) of the Total Bid Price.
 - W. "SUBCONTRACTOR": A person, firm or corporation supplying labor and materials or only labor for the Work, and under a separate Contract Agreement with the Contractor.
 - X. "SUBSTANTIAL COMPLETION": The time as specified in the City's Standard Agreement., at which time the Work has progressed to a point whereas the Work is sufficiently complete so that the Work, at the City's discretion, can be utilized and/or occupied.
 - Y. "SUCCESSFUL BIDDER": The lowest responsible bidder to whom the City awards the Contract.
 - Z. "SUPPLEMENTAL CONDITIONS": The part of the Contract Documents which amends or supplements the General Conditions.
 - AA. "TECHNICAL SPECIFICATIONS": The City of Friendswood Technical Specifications (CFTS) and all other Specifications added to the Project Manual by the Design Professional for necessary completion of the Work.
 - AB. "TOTAL BID PRICE": The total amount bid for performing the Work as identified by Bidder and including any and all alternates and allowances.
 - AC. "WORK": The entire construction required to be provided under the Contract Documents which includes, but is not limited to, performing or providing labor, services, documentation and the furnishing, installation and incorporation of materials and equipment as required by the Contract Documents.
 - AD. "WORKING DAY": Any calendar day from Monday through Friday, excluding City Holidays, in which four (4) or more consecutive hours of work on the Critical Path can be performed between the hours of seven (7) A.M. and eight (8) P.M. inclusive.
3. **TERMINATION OF CONTRACT FOR CAUSE**
- If, through any cause, the Contractor shall fail to fulfill in a timely and proper manner the Contractor's obligations under this Contract, or if the Contract shall violate any of the covenants, agreements or stipulations of this Contract, the City shall thereupon have the right to terminate this Contract by giving written notice to

the Contractor and specifying the effective date thereof, at least five (5) days before the effective date of such termination. In such event, all finished or unfinished Documents, data, studies, surveys, drawings, maps, models, photographs and reports prepared by the Contractor under this Contract shall, at the option of the City, become its property and the Contractor shall be entitled to receive just and equitable compensation for any work satisfactorily completed hereunder. Notwithstanding the above, the Contractor shall not be relieved of liability to the City for damages sustained by the virtue of any breach of the Contract by the Contractor, and the City shall withhold any payments due to the Contractor for the purpose of set-off until such time as the exact amount of damages due the City from the Contractor is determined.

City also has the right to breach the Contract by anticipated repudiation if the rate of progress of the Work is so behind that the Contractor cannot finish on time.

4. PERSONNEL

- A. The Contractor represents that he has, or will secure at his own expense, all personnel required in performing the Work under the Contract. Such personnel shall not be employees of or have any contractual relationship with the City.
- B. All work required hereunder shall be performed by the Contractor or under his supervision and all personnel engaged in the Work shall be fully qualified and shall be authorized or permitted under state and local law to perform such services.
- C. None of the Work covered by this Contract shall be subcontracted without prior written approval of the City. Any work or services subcontracted hereunder shall be specified by written Contract or agreement and shall be subject to each provision of this Contract.

5. REPORTS AND INFORMATION

The Contractor, at such times and in such forms as the City shall require, shall furnish the City such periodic reports as it may request pertaining to the Work or services undertaken pursuant to this Contract, the costs and obligations incurred or to be incurred in connection therewith, and any other matters covered by this Contract.

6. RECORDS AND AUDITS

The Contractor shall maintain accounts and records, including personnel, property and financial records, adequate to identify and account for all costs pertaining to the Contract and such other records as may be deemed necessary by the City to assure proper accounting for all project funds, both federal and non-federal.

These records shall be made available for audit purposes to the City or any authorized representative, and shall be retained for three (3) years after the expiration of this Contract unless permission to destroy them is granted by the City.

7. FINDINGS CONFIDENTIAL

All of the reports, information, data, etc., prepared or assembled by the Contractor under this Contract are confidential and the Contractor agrees that they shall not be made available to any individual or organization without the prior written approval of the City.

8. COPYRIGHT

No report, maps, or other Documents produced in whole in part under this Contract shall be subject of an application for copyright by or on behalf of the Contractor.

9. COMPLIANCE WITH LAWS

The Contractor shall comply with all applicable laws, ordinances, rules, orders, regulations, and codes of federal, state, and local governments relating to performance of the Work herein, the protection of adjacent property and the maintenance of passageways, guard fences or other protective facilities. The Contractor shall also comply with the Construction Storm Preparation Policy.

Failure of the Contractor to comply with all federal, state, and local applicable laws, ordinances, rules, order, regulations and codes, whether through lack of knowledge or negligence, does not relieve the Contractor to bring the Work into compliance at no additional cost to the City.

10. INTEREST OF MEMBERS OF THE CITY

No member of the governing body of the City, and no other officer, employee or agent of the City, who exercises any functions or responsibilities in connection with the planning and carrying out of the program, shall have any personal financial interest, direct or indirect, in this Contract; and, the Contractor shall take appropriate steps to assure compliance.

11. INTEREST OF OTHER LOCAL PUBLIC OFFICIALS

No member of the governing body of the locality and no other public official of such locality, who exercises any functions or responsibilities in connection with the planning and carrying out of the program, shall have any personal financial interest, direct or indirect, in this Contract; and, the Contractor shall take appropriate steps to assure compliance.

12. INTEREST OF CONTRACTOR AND EMPLOYEES

The Contractor covenants that he presently has no interest and shall not acquire any interest, direct or indirect, in the study area or any parcels therein or any other interest which would conflict in any manner or degree with the performance of his services hereunder. The Contractor further covenants that in the performance of this Contract, no person having any such interest shall be employed.

13. INCORPORATION OF PROVISIONS REQUIRED BY LAW

Each provision and clause required by law to be inserted into the Contract shall be deemed to be enhanced herein and the Contract shall be read and enforced as

though each were included herein. If, through mistake or otherwise, any such provision is not inserted or is not correctly inserted, the Contract shall be amended to make such insertion on application by either party.

14. CERTIFICATES AND PERMITS

Except for required permits issued by the City, which shall be issued at no cost to the Contractor, the Contractor shall secure, at their own expense, from other public authorities all necessary certificates, licenses, approvals and permits required in connection with the Work of this Contract or any part thereof, and shall give all notices required by law, ordinance or regulation. It is the duty of the Contractor to know and find out what permits are needed. The Contractor shall pay all fees and charges incident to the due and lawful prosecution of the Work of this Contract, and any extra work performed by the Contractor.

15. GUARANTEE OF WORK

- A. Neither the Notice of Final Completion, the Final Payment nor any other provision in the Contract Documents nor partial or entire occupancy of the premises by the City shall constitute an acceptance of work not done in accordance with the Contract Documents or relieve the Contractor of liability in respect to any warranties or responsibility for faulty materials or workmanship. The Contractor guarantees and warrants that all materials and equipment which are to become part of the Work shall be new unless otherwise specified and that all work shall be of good quality and free from faults and defects and in accordance with the Contract Documents and of any inspections, tests or approvals required by the Contract Documents, law, ordinance, rules, regulations or orders of any public authority having jurisdiction. The City shall give notice of observed defects within reasonable promptness.
- B. Neither observations by the City's Design Professional nor inspections, tests or approvals by persons other than the Contractor shall relieve the Contractor from their obligations to perform the Work in accordance with the requirements of the Contract.
- C. The provisions of this paragraph shall be cumulative of and not in limitation of the responsibility of the Contractor for defects in the Work or materials or damages resulting therefrom as otherwise provided by the law of the State of Texas or this Contract, including, without limitation, the implied warranty of fitness of the Work and the implied obligation to perform the Work in a good and workmanlike manner.

16. ADDITIONAL INSTRUCTIONS AND DETAIL DRAWINGS

The Contractor shall be furnished additional instructions and detail drawings as necessary to carry out the Work included in the Contract. The additional drawings and instructions thus supplied to the Contractor will coordinate with the Contract Documents and shall be so prepared that they can be reasonably interpreted as part thereof. The Contractor shall carry out the Work in accordance with the additional detail drawings and instructions. The Contractor and the City's Design Professional shall jointly (a) a schedule, fixing the dates at which special drawings

will be required, such drawings, if any, to be furnished by the City's Design Professional in accordance with said schedule, and (b) a schedule fixing the respective dates for the submission of shop drawings, the beginning of manufacture, testing and installation of materials, supplies and equipment, and the completion of the various parts of the Work; each schedule to be subject to change from time to time in accordance with the progress of the Work.

17. SHOP OR SETTING DRAWINGS

The Contractor shall submit promptly to the City's Design Professional two (2) copies of each shop or setting drawing prepared in accordance with the schedule predetermined as aforesaid. After examination of such drawings by the City's Design Professional and the return thereof, the Contractor shall make such corrections to the drawings as have been indicated and shall furnish the City's Design Professional with two (2) corrected copies. Regardless of corrections made in or approval given to such drawings by the City's Design Professional, the Contractor shall nevertheless be responsible for the accuracy of such drawings and for their conformity to the Drawings and Technical Specifications, unless the Contractor notifies the City's Design Professional in writing of any deviations at the time such drawings are furnished.

18. MATERIALS, SERVICES, AND FACILITIES

- A. It is understood that, except as otherwise specifically stated in the Contract Documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, superintendents, temporary construction of every nature and all other services and facilities of every nature whatsoever necessary to execute, complete and deliver the work within the specified time.
- B. Any work necessary to be performed after regular working hours on Saturdays, Sundays or legal City Holidays shall be performed without any additional expense to the City. Such work shall only be performed after written notice is given to and approval given by the City. Notice shall be a minimum of forty-eight (48) hours previous to the commencement of such work and only within the specifications specified in Work Restrictions.

19. CONTRACTOR'S TITLE TO MATERIALS

No materials or supplies for the Work shall be purchased by the Contractor or by any Subcontractor subject to any chattel mortgage or under a conditional sale Contract or other agreement by which an interest is retained by the seller. The Contractor warrants that they have good title to all materials and supplies used by the Contractor in the Work, free from all liens, claims, or encumbrances.

20. INSPECTION AND TESTING OF MATERIALS

- A. All materials and equipment used or any infrastructure produced in the construction of the project shall be subject to adequate inspection and testing in accordance with accepted standards. The laboratory or inspection agency shall be selected by the City. The City shall pay for all first (1st) laboratory inspection services directly and not as a part of the Contract. Should any

materials, equipment or infrastructure fail the first (1st) test, the Contractor shall pay for all subsequent testing to show that items meet the specifications of the Contract.

- B. Materials of construction, particularly those upon which the strength and durability of the structure may depend, shall be subject to inspection and testing to establish conformance with the Technical Specifications and suitability for uses intended.

21. "OR EQUAL" CLAUSE

Whenever a material, article or piece of equipment is identified on the Drawings or in the Technical Specifications by reference to manufacturers' or vendors' names, trade names, catalogue numbers, etc., it is intended merely to establish a standard; and, any material, article or equipment of other manufacturers and vendors which shall perform adequately the duties imposed by the general design shall be considered equally acceptable provided the material, article or equipment so proposed is, in the opinion of the City's Design Professional, of equal substance and function. It shall not be purchased or installed by the Contractor without the City's Design Professional's and the City's written approval.

The "or equal" clause shall only pertain to materials, articles or equipment specified or identified as such. Material, articles, or equipment not listed as such shall not be substituted.

22. PATENTS

- A. The Contractor shall indemnify, defend, and hold and save the City and its officers, agents, servants and employees harmless from liability of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article or appliance manufactured or used in the performance of the Contract, including its use by the City, unless otherwise specifically stipulated in the Contract Documents.
- B. License or Royalty Fees: License and/or royalty fees for the use of a process which is authorized by the City for a project shall be reasonable and paid to the holder of the patent or their authorized licensee, direct by the City and not by or through the Contractor.
- C. If the Contractor uses any design, device, or materials covered by letters of patent or copyright, he shall provide for each use by suitable agreement with the City of such patented or copyrighted design, device, or material. It is mutually agreed and understood that, without exception, the Contract prices shall include all royalties or costs arising from the use of such design, device, or materials in any way involved in the Work. The Contractor and/or his Sureties shall indemnify, defend and save harmless the City from any and all claims for infringement by reason of the use of such patented or copyrighted design, device or materials or any trademark or copyright in connection with work agreed to be performed under this Contract, and shall indemnify the City for any cost, expense or damage which it may be obliged to pay by reason of such infringement at any time during the prosecution of the Work or after completion of the Work.

23. SURVEYS

Unless otherwise expressly provided for in the Technical Specifications, the City shall furnish the Contractor all surveys necessary for the execution of the Work. At the beginning of the project the City shall have a surveyor set vertical and horizontal control points. All other surveying for construction and progression of the Work shall be the Contractors responsibility and incidental to the Contract.

24. CONTRACTORS OBLIGATIONS

The Contractor shall, in good workmanlike manner, do and perform all work and furnish all supplies and materials, machinery, equipment, facilities and means, except otherwise expressly specified, necessary or proper to perform and complete all the Work required by this Contract, within the time herein specified, in accordance with the provisions of this Contract and any said Technical Specifications and in accordance with the Drawings covered by this Contract and any and all supplemental drawings and specifications, and in accordance with the directions of the City's Design Professional as given from time to time during the progress of the Work. The Contractor shall furnish, erect, maintain, and remove such construction plant and such temporary works as may be required.

The Contractor shall observe, comply with and be subject to all terms, conditions, requirements and limitations of the Contract and Technical Specifications, and shall do, carry on and complete the entire work to the satisfaction of the City and the City's Design Professional.

25. INSURANCE

The Contractor shall not commence and work under this Contract until all insurance required herein has been obtained and such insurance has been approved by the City, nor shall the Contractor allow any Subcontractor to commence work on this Subcontract until the insurance required of the Subcontractor has been so obtained and approved.

All insurance shall be written by an insurer licensed to conduct business in the State of Texas.

26. SPECIAL CONDITIONS PERTAINING TO HAZARDS, SAFETY STANDARDS, AND ACCIDENT PREVENTION

A. Lead Based Paint Hazards:

(Applicable to Contracts for construction or rehabilitation of residential structures.)

The construction or rehabilitation of residential structures is subject to the HUD Lead-Based Paint regulations, 24 CFR Part 35. The Contractor and Subcontractors shall comply with the provisions for the elimination of lead-base paint hazards under subpart B of said regulations. The City shall be responsible for the inspections and certifications required under Section 35.14(f) thereof.

B. Use of Explosives:

When use of explosives is necessary for the prosecution of the Work, the Contractor shall observe all local, state, and federal laws in purchasing and handling explosives. The Contractor shall take all necessary precautions to protect completed work, neighboring property and all underground structures and utilities.

The Contractor shall notify all owners of public utility property of the intention to use explosives at least forty-eight (48) hours before blasting is done, close to such property. Any supervision or direction of use of explosives by the City does not in any way reduce the responsibility of the Contractor or his Surety for damages that may be caused by such use.

The Contractor shall subcontract to a company or firm that is licensed by state and federal entities for the purchase, transport, and use of such explosives. Subcontractor shall have a minimum of ten (10) years experience and shall be subject to the approval and verification of the City.

C. Danger Signals and Safety Devices (Modify as Required):

The Contractor shall make all necessary precautions to guard against damages to property and injury to persons. The Contractor shall put up and maintain in condition sufficient of red or warning lights at night, suitable barricades and other devices and signage necessary to protect the public. In case the Contractor fails or neglects to take such precautions or maintain same, the City shall have such lights, barricades, devices and/or signage installed and charge the cost of this work to the Contractor. Such action by the City does not relieve the Contractor of any liability incurred under these Technical Specifications or Contract. All such Signals or devices shall comply with the latest edition of The Texas Manual on Uniform Traffic Control Devices (TMUTCD).

27. SUSPENSION OF WORK

Should the City be prevented or enjoined from proceeding with work or from authorizing its prosecution either before or after its prosecution, by reason of any litigation, the Contractor shall not be entitled to make or assert claim for damage by reason of said delay, but time completion of the Work shall be extended to such reasonable time as the City shall determine will compensate for time lost by such delay with such determination to be set forth in writing.

28. SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION

In order to protect the lives and health of the Contractor's employees under the Contract, the Contractor shall comply with all pertinent provisions of the Contract Work Hours and Safety Standards Act, as amended, commonly known as Construction Safety Act as pertains to health and safety standards; and shall maintain an accurate record of all cases of death, occupational disease and injury requiring medical attention or causing loss of time from work, arising out of and in the course of employment on the Work under this Contract.

The Contractor alone shall be responsible for the safety, efficiency, and adequacy of the project, appliance, and methods, and for any damage which may result from their failure or their improper construction, maintenance or operation.

29. USE AND OCCUPANCY PRIOR TO ACCEPTANCE BY THE CITY

The Contractor agrees to the use and occupancy of a portion or unit of the project before formal acceptance by the City, provided the City:

- A. Secures written consent of the Contractor except in the event, in the opinion of the City or the City's Design Professional, the Contractor is chargeable with unwarranted delay in completing the Contract requirements;
- B. Secures consent of Surety;
- C. Secures endorsement from insurance carrier(s) permitting occupancy of the building or use of the project during the remaining period of construction; or,
- D. When the project consists of more than one (1) building and one (1) of the buildings is occupied, secures permanent fire and extended coverage insurance, including a permit from the insurance construction.

Use and occupancy shall not be allowed without the approval of the City's Design Professional, the Director of Community Development, and the City Manager. All conditions and terms for occupancy prior to acceptance shall be written and agreed to by the Contractor and the City.

30. USE OF PREMISES AND REMOVAL OF DEBRIS

The Contractor expressly undertakes at the Contractor's expense:

- A. To take every precaution against injuries to persons or damage to property;
- B. To store apparatus, materials, supplies and equipment in such orderly fashion at the site of the Work as will not unduly interfere with the progress of the Work or any other Contractor or Subcontractors work;
- C. To place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work;
- D. To clean up frequently all refuse, rubbish, scrap materials and debris caused by construction operations, to the end that at all times the site of the Work shall present a neat, orderly and workmanlike appearance;
- E. Before Final Payment to the Contractor, removal of all surplus material not to be kept and stored, false work temporary structures, including foundations thereof, plant of any description and debris of every nature resulting from the Contractor's operations, and to put the site in a neat, orderly condition.
- F. To effect all cutting, fitting or patching of the Contractor's work required to make the same conform to the Drawings and Technical Specifications and, except with the consent of the City and the City's Design Professional, not to cut or otherwise alter the Work of any other Contractor.

31. QUANTITIES OF ESTIMATE

Wherever the estimated quantities of the Work to be done and materials to be furnished under this Contract are shown in any of the documents including the proposal, they are given for use in comparing bids and the right shall be reserved, except herein otherwise specifically limited, to increase or diminish them as deemed reasonably necessary or desirable by the City to complete the Work

contemplated by the Contract, and such increase or diminution shall in no way vitiate this Contract, nor shall any such increase or diminution give cause for claims or liability for damages.

All quantities shall be based on exact or near exact usage of items actually installed and incorporated into the Work.

32. LAND AND RIGHTS-OF-WAY

Prior to the start of construction, the City shall obtain all lands and rights-of-way necessary for the carrying out and completion of the Work to be performed under this Contract.

33. NOTICE AND SERVICE THEREOF

Any notice to any Contractor from the City relative to any part of this Contract shall be in writing and considered delivered and service thereof completed when said notice is posted, certified or registered mail, to the said Contractor at the last given address or delivered in person to the said Contractor or duly authorized representative on the Work.

34. SEPARATE CONTRACT

The Contractor shall coordinate operations with those of other Contractors. Cooperation shall be required in the arrangement for the storage of materials and in detailed execution of the Work. The Contractor, including the Subcontractors, shall keep informed of the progress and detail work of other Contractors and shall notify the City's Design Professional immediately of lack of progress or defective workmanship on the part of other Contractors.

Failure of a Contractor to keep informed of the Work progressing on the site and failure to give notice of lack of progress or defective workmanship by others shall be construed as acceptance by the Contractor of the status of the Work as being satisfactory for proper coordination with the Contractors own work.

35. SUBCONTRACTING

- A. The Contractor may utilize the services of specialty Subcontractors on those parts of the Work which, under normal contracting practices, are performed by specialty Subcontractors.
- C. The Contractor shall be as fully responsible to the City for the acts or omissions of Subcontractors performing work under the Contractors supervision, and of persons directly or indirectly employed by said Subcontractor, as the Contractor is for acts and omission for persons directly employed by the Contractor.
- D. The Contractor shall cause appropriate provisions to be inserted in all Subcontracts relative to the Work to bind Subcontractors to the Contractor by terms of the General Conditions and Contract Documents insofar as applicable to the Work of Subcontractors and to give the Contractor the same power as regards terminating any Subcontractor that the City may exercise over the Contractor under any provision of the Contract Documents.

- E. Nothing contained in this Contract shall create any contractual relation between any Subcontractor and the City.
36. **THE CITY'S DESIGN PROFESSIONAL AUTHORITY**
The City's Design Professional shall convey all orders and directions contemplated under this Contract and Technical Specifications, relative to the execution of the Work. The City's Design Professional shall determine the amount, quality, acceptability, and fitness of the several kinds of work and materials which shall be paid for under this Contract and shall decide all questions which may arise in relation to said work and the construction thereof. The City's Design Professional's estimates and decisions shall be final and conclusive, except as herein otherwise expressly provided. In case any questions shall arise between the parties hereto relative to said Contract or Technical Specifications, the determination or decision of the City's Design Professional shall be condition precedent to right of the Contractor to receive any monies or payment for work under this Contract affected in any manner or to any extent by such question.
37. **MEANING AND INTENT**
The City's Design Professional shall decide the meaning and intent of any portion of the Technical Specifications and of any Drawings where the same may be found obscure or be in dispute. Any differences or conflicts in regard to their work which may arise between the Contractor, under this Contract and other Contractors, performing work for the City, shall be adjusted and determined by the City's Design Professional.
38. **CONTRACT SECURITY**
If the Contract amount exceeds Twenty-Five Thousand Dollars (\$25,000), a Payment Bond shall be furnished, and if the Contract amount exceeds One Hundred Thousand Dollars (\$100,000) a Performance Bond also shall be furnished, on prescribed forms in the amount of one hundred percent (100%) of the Contract amount as prescribed by the state, territorial or local law, as security for the payment of all persons performing labor on the project under this Contract and furnishing materials in connection with this Contract and as security for faithful performance of this Contract.
39. **ADDITIONAL OR SUBSTITUTE BOND**
If at any time the City, for justifiable cause, shall be or become dissatisfied with any Surety or Sureties for the Performance and/or Payment Bonds, the Contractor shall, within five (5) working days after notice from the City to do so, substitute an acceptable bond (or bonds) in such form and sum and signed by such Surety or Sureties as may be satisfactory to the City. The premiums on such bond shall be paid by the Contractor. No further payments shall be deemed due nor shall be made until the new Surety or Sureties shall have furnished such an acceptable bond to the City.

For Final Acceptance, the Contractor shall supply a One-year Maintenance Bond dated the date of Council Acceptance, and effective for One-year, in the total amount of the Contract.

40. ASSIGNMENTS

The Contractor shall not assign the whole or any part of this Contract or any monies due or to become due hereunder without written consent of the City. In case the Contractor assigns all or part of the monies due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that is agreed that the right of the assignee in and to any monies due or to become due to the Contractor shall be subject to prior claims of all persons, firms and corporations of services rendered or materials supplied for the performance of the Work called for this Contract.

41. MUTUAL RESPONSIBILITY OF CONTRACTORS

If, through acts of neglect on the part of the Contractor, and other Contractor or any Subcontractor shall suffer loss or damage on the Work, the Contractor agrees to settle with such other Contractor or Subcontractor by agreement or arbitration if such other Contractor or Subcontractor shall so settle. If such other Contractor or Subcontractor assert any claim against the City on account of damage alleged to have been sustained, the City shall notify the Contractor, who shall indemnify and hold harmless the City against any such claim.

42. ACCEPTANCE OF FINAL PAYMENT CONSTITUTES RELEASE

The acceptance by the Contractor of the Final Payment shall be and shall operate as a release to the City of all claims and all liability to the Contractor for all things done or furnished in connection with this work. No payment, however, final or otherwise, shall operate to release the Contractor or the Contractors Sureties from any obligations under this Contract or the Performance, Payment or Maintenance Bonds.

43. PAYMENTS BY THE CONTRACTOR

The Contractor shall pay the following:

- A. For all transportation and utility services no later than the twentieth (20th) day of the calendar month following that in which the services are rendered;
- B. For all materials, tools, and other expendable equipment to extent of ninety percent (90%) cost thereof, no later than the twentieth (20th) day of the calendar month following that in which such materials, tools and equipment are delivered at the site of the project, and the balance of the cost thereof, no later than the thirtieth (30th) day following the completion of that part of the Work in or on which such materials, tools and equipment are incorporated or used; and
- C. To each of the Subcontractors under contract to the Contractor, no later than the fifth (5th) day following each payment to the Contractor, the respective amounts allowed the Contractor on account of work performed by said Subcontractors to the extent of each Subcontractors interest therein.

44. CONSTRUCTION SCHEDULE AND PERIODIC ESTIMATES

Immediately after execution and delivery of the Contract, and before the first progress payment is made, the Contractor shall deliver to the City an estimated construction progress schedule in form satisfactory to the City, showing proposed dates of commencement and completion of each of the various subdivisions of work required under the Contract Documents and the anticipated amount of each monthly payment that shall become due the Contractor in accordance with the project schedule. The Contractor shall also furnish on forms to be supplied by the City:

- A. A detailed estimate giving complete breakdown of the Contract Price and;
- B. Periodic itemized estimates of work done for the purpose of making progress payments thereon. The costs employed in making up any of these schedules shall be used only for determining the basis of progress payments and shall not be considered as fixing basis for additions to or deductions from the Contract Price.

45. PAYMENTS TO THE CONTRACTOR

- A. Not later than the twentieth (20th) day of each calendar month, the City shall make a progress payment to the Contractor on the basis of a duly certified and approved estimate of the work performed during the preceding calendar month under this Contract, but to insure proper performance of the Contract, the City shall retain ten percent (10%) [five percent (5%) if the total Contract Price exceeds Five Hundred Thousand Dollars (\$500,000)] of the amount of each estimate until Final Completion and acceptance of all work covered by this Contract; provided that the Contractor shall submit the estimate no later than the fifth (5th) day of the calendar month. Provided further, that on completion and acceptance of each separate building, public work or other division of the Contract on which the price is stated separately in the Contract, payment may be made in full, including retained percentages thereon, less authorized deductions.
- B. In preparing estimates, the material delivered on the site and preparatory work done may be taken into consideration.
 - 1) Materials shall only be taken into consideration with validation by invoice, or other document showing the materials are paid, and if allowed only in the amount invoiced.
- C. All material and work covered by progress payments made shall thereupon become the sole property of the City, but this provision shall not be construed as relieving the Contractor from the sole responsibility for the care and protection of materials and work upon which payments have been made or the restoration of any damaged work or as a waiver of the right of the City to require the fulfillment of all of the terms of the Contract.
- D. The City's Right to Withhold Certain Amounts and Make Application Thereof: The Contractor agrees that they will indemnify, defend and save the City harmless from all claims growing out of lawful demands of Subcontractors, labors, workmen, mechanics, materialmen and furnishers of machinery and parts thereof, equipment, power tools and all supplies, including commissary, incurred in the furtherance of the performance of this Contract. The

Contractor shall, at the City's request, furnish satisfactory evidence that all obligations of the nature hereinabove designated have been paid, discharged, or waived. If the Contractor fails to do so, the City shall, after having served written notice on the said Contractor, the City shall either:

- 1) Withhold from said Contractors 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 the Contractor shall be resumed, in accordance with the terms of this Contract, but in no event shall provisions of this sentence be construed to impose any obligations upon the City to either the Contractor or the Contractors Surety; or
 - 2) Pay unpaid bills direct on which the City has given written notice. In paying any unpaid bills of the Contractor, the City shall be deemed the agent of the Contractor, and any payment so made by the City shall be considered as a payment made under the Contract by the City and the Contractor and the City shall not be liable to the Contractor for any such payments made in good faith. This provision shall not be construed to give rise to any third party beneficiary rights in claimants.
 - 3) If in the opinion of the City the Contractor cannot in due diligence make payment to Subcontractors, suppliers or other debt incurred as a result of the Work or the non-payment is a recurring problem, the City shall immediately notify the Contractors Surety and make claim on the Payment Bond.
- E. Monies in dispute, either due to non-payment as specified above, if more monies withheld from the Contractor than can be justified, and payment to the Contractor has passed beyond one (1) progress payment, the Contractor shall be due interest on the unjustified part of the amount withheld. If the Contractor fails to pay Subcontractors, suppliers or other debt past one (1) progress payment, subcontractors, supplies, or other debt shall be entitled to interest payments on monies owed from the Contractor.

Payments due and unpaid under Contract Documents shall bear interest from the date payment is due at such rate as the legal rate prevailing at the time at the place where project is located.

46. CORRECTION OF WORK

All work, all materials, whether incorporated in the Work or not, all processes of manufacture and all methods of construction shall be at all times and places subject to inspection of the City's Design Professional who shall be the final judge of the quality and suitability of the Work, materials, processes for manufacture and methods of construction for the purposes for which they are used. Should they fail to meet the City's Design Professional's approval, they shall be forthwith reconstructed, made good, replaced, and/or corrected, as the case may be, by the Contractor at the Contractors expense. If, in the opinion of the City's Design Professional, it is undesirable to replace any defective or damaged materials or to reconstruct or correct any portion of the Work injured or not performed in accordance with the Contract Documents, the compensation to be paid to the

Contractor hereunder shall be reduced by such amount as in the judgment of the City and the City's Design Professional is determined to be equitable.

If the Contractor cannot or will not remedy the Work that the Contractor has been notified is defective, the City shall give written notice for the Contractor to bring such defective work into compliance with the Contract Documents in a reasonable number of days. If the Contractor fails to take corrective action, then the City shall have the defective work corrected and deduct the cost from the Contract.

47. SUBSURFACE CONDITIONS

Should the Contractor encounter subsurface and/or latent conditions at the site materially differing from those shown on the Drawings or indicated in the Technical Specifications, the Contractor shall immediately give notice to the Project Manager and the City's Design Professional of such conditions before they are disturbed. The City's Design Professional shall thereupon promptly investigate the conditions and, if the City's Design Professional finds that they materially differ from those shown on the Drawings or indicated in the Technical Specifications, the City's Design Professional shall at once make such changes in the Drawings and/or Technical Specifications as shall be necessary. Any increase or decrease of the cost resulting from such changes shall be adjusted in the manner provided in Paragraph 49 of the General Conditions.

48. CLAIMS FOR EXTRA COST

No claim for extra work or cost shall be allowed unless the same was done pursuant to a written order of the City's Design Professional and approved by the City, as aforesaid, and the claim presented with the first (1st) estimate after the changed or extra work is done. When work is performed under the terms of Paragraph 49.C of the General Conditions, the Contractor shall furnish satisfactory bills, payrolls, and vouchers covering all items of cost and when requested by the City, shall give the City access to accounts relating hereto.

49. CHANGES IN WORK

No changes in the Work covered by the approved Contract Documents shall be made without having prior written approval of the City. Any work undertaken by the Contractor that changes work covered by the approved Contract Documents shall be at the Contractor's own risk and no claim shall be made against the City if said work is not approved for change.

- A. Unit Bid Prices previously approved by the Contract Documents.
- B. An agreed Lump Sum.
- C. Time and material, in which the actual cost shall be:
 - 1) Labor, including foreman;
 - 2) Materials entering permanently into the Work;
 - 3) Ownership or rental cost of construction plant and equipment during the time of use on the extra work;
 - 4) Power and consumable supplies for operation of power equipment;
 - 5) Insurance;
 - 6) Social Security and old age unemployment contributions.

To the cost under subparagraph C of Paragraph 49 there shall be added a fixed fee to set at ten percent (10%) of the extra work. The fee shall be compensation to cover the cost of supervision, overhead, bond, profit, and any other general expenses.

50. EXTRAS

Without invalidating the Contract, the City may, to the extent allowed by law, order extra work or make changes by altering, adding to or deducting from the Work, the Contract sum being adjusted accordingly, and consent of the Surety being first (1st) obtained where necessary or desirable. All the Work of the kind bid upon shall be paid for at the price stipulated in the proposal and no claims for any extra work or materials shall be allowed unless the work ordered in writing by the City or the City's Design Professional and approved by the City, acting officially for the City, and the price stated in such order.

51. TIME FOR COMPLETION AND LIQUIDATED DAMAGES

- A. It is hereby understood and mutually agreed, by and between the Contractor and the City, that the date of beginning and the time of completion as specified in the Contract of work to be done hereunder are ESSENTIAL CONDITIONS of this Contract; and it is further mutually understood and agreed that the Work embraced in this Contract shall be commenced on a date specified in the Notice To Proceed.
- B. The Contractor agrees that said Work shall be prosecuted regularly, diligently and without interruption at such rate of progress as will insure full completion thereof within the time specified. It is expressly understood and agreed, by and between the Contractor and the City, that the time for completion of the Work described herein is a reasonable time for the completion of same, taking into consideration the average climatic range and industrial conditions prevailing in this locality. City reserves the right to terminate this agreement, and breach by repudiation, without penalty, if the rate of progress is so behind schedule that full completion thereof cannot reasonably be accomplished within the time specified.
- C. If the said Contractor shall neglect, fail or refuse to complete the Work within the time herein specified, or any proper extension thereof granted by the City, the Contractor does hereby agree, as a part consideration for awarding of this Contract, to pay to the City the amount specified in the Contract, not as a penalty, but as liquidated damages for such breach of Contract as hereinafter set forth, for each and every consecutive working day that the Contractor shall be in default after the time stipulated in the Contract for completing the Work.
- D. The said amount stated in the City's Standard Agreement is fixed and agreed upon by and between the Contractor and City because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the City would in such event sustain, and said amount is agreed to be the amount of damages which the City would sustain and said amount shall be retained from time to time by the City from current periodical estimates.
- E. It is further agreed that time is of the essence of each and every portion of

this Contract and of the Technical Specifications wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the Contract an additional time is allowed for the completion of any work, the new time limit fixed by such an extension shall be of the essence of this Contract. Provided, that the Contractor shall not be charged with any liquidated damages or any excess cost when the City determines that any part of the liquidated damages was not the fault of the Contractor and the City determines that the request for extension by the Contractor is justified and due to:

- 1) Any preference, priority, or allocation duly issued by the government;
 - 2) The following unforeseeable causes namely acts of the public enemy, unjustified acts of the City, acts of another Contractor in performance of a Contract with the City, fires, floods, earthquakes, hurricanes, tornadoes, epidemics and any other acts of nature, quarantine restrictions, strikes, freight embargos; and rainy days claimed by the Contractor; however rainy days shall be considered only if the Contractor notifies the City on the day the Contractor claims he cannot work because of rainy weather that day. Rainy day must be as is specified in Paragraph 51.E.3 below. Failure to report the rainy day and to claim said rainy day on a Time Request shall eliminate any claim for time extension because of rain or inclement weather on that day.
 - 3) Rainy day shall be described as when a minimum of sixty percent (60%) of the Contractors workforce cannot work for four (4) or more consecutive hours on critical path activities and providing that the Contractor has complied with the conditions under Paragraph 51.E.2.
 - 4) Any delays of Subcontractors or suppliers occasioned by any of the causes specified in subparagraphs one (1) and two (2) of this Paragraph.
- F. Provided, further, that the Contractor shall, within ten (10) days from beginning of such delay, unless the City shall grant a further period of time prior to the date of final completion of the Contract, notify the City, in writing, of the causes of delay, who shall ascertain the facts and extent of delay and notify the Contractor within reasonable time of the City's decision in the matter.
- G. Provided, that this provision for liquidated damages shall be cumulative of and not in limitation of any other remedy available to the City, including, but without limitation, the right to terminate as provided in Paragraph 3 of the General Conditions and recover additional damages for any excess cost in otherwise completing the Work.
- H. The City shall, if it deems necessary, start charging liquidated damages equal to the amount of time over the date of Final Completion listed in the Notice To Proceed. This date shall be adjusted using current changes in Contract Time and allowable Weather Days. The amount of liquidated damages shall be deducted from the next Pay Estimate submitted by the Contractor.

52. WEATHER CONDITIONS

In the event of temporary suspension of work, or during inclement weather, or whenever the City's Design Professional shall direct, the Contractor shall cause the Subcontractors to protect carefully all work and materials against damage or injury from the weather. If, in the opinion of the City's Design Professional, any work or materials shall have been damaged or injured by reason of failure on the part of the Contractor or any of the Subcontractors so to protect the Work, such materials and work shall be removed and replaced at the expense of the Contractor.

53. PROTECTION OF THE WORK AND PROPERTY – EMERGENCY

- A. The Contractor shall at all times safely guard the City's property from injury or loss in connection with this Contract. The Contractor shall at all times safely guard and protect the Work and that of adjacent property, from damage. The Contractor shall replace or make good any such damage, loss or injury unless such be caused directly by errors contained in the Contract, by the City or the City's duly authorized representatives.
- B. In case of an emergency which threatens loss or injury of property and/or safety of life, the Contractor shall be allowed to act, without previous instructions from the City or the City's Design Professional, in a diligent manner. The Contractor shall notify the City or the City's Design Professional immediately thereafter. Any claim for compensation by the Contractor due to such extra work shall promptly be submitted to the City or the City's Design Professional.
- C. Where the Contractor has not taken action but has notified the City or the City's Design Professional of an emergency threatening injury to persons or damage to the Work or any adjoining property, the Contractor shall act as instructed by the City or the City's Design Professional.
- D. The amount of reimbursement claimed by the Contractor on account of any emergency action shall be determined in the manner provided for in the General Conditions.

54. INSPECTION

The authorized representatives and agents of the City shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials and other relevant data. The Contractor shall not impede and allow unrestricted access to the Project Mangers, Building Official, and Testing Laboratory personnel.

55. SUPERINTENDENCE BY CONTRACTOR

At the site of the Work, the Contractor shall employ a construction superintendent or foreman who shall have full authority to act for the Contractor. It is understood that the representative shall be acceptable to the City's Design Professional and shall remain in such capacity for the particular job involved unless superintendent ceases to be on the Contractors payroll.

56. FEDERAL LABOR STANDARDS PROVISIONS

All laborers and mechanics employed upon the Work covered by this Contract shall be paid unconditionally and not less than once each week and without subsequent deduction or rebate on any account (except such payroll deductions as are mandatory by law and such other payroll deductions as are permitted by the applicable regulations issued by the Secretary of Labor, United States Department of Labor, pursuant to the Anti-Kickback Act hereinafter identified) the full amount due at time of payment computed at wage rates not less than those contained in the wage determination decision of said Secretary of Labor, regardless of any contractual relationship which may be alleged to exist between the Contractor or any Subcontractor and such laborers and mechanics. All laborers and mechanics employed upon such work shall be paid in cash, except that payment may be by check if the employer provides or secures satisfactory facilities approved by the City for the cashing of same without cost or expense to the employee. For the purpose of this clause, contributions made or costs reasonably anticipated under Section 1(b)(2) of the Davis Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of Section 5.5(a)(1)(iv) of Title 29, Code of Federal Regulations. Also, for the purpose of this clause, regular contributions made or costs incurred more than a weekly period under plans, funds, or programs, but covering the particular work week, are deemed to be constructively made or incurred during such weekly period.

57. UNDERPAYMENTS OF WAGES OR SALARIES

In case of underpayment of wages by the Contractor or by any subcontractors to laborers or mechanics employed by the Contractor or Subcontractor upon the Work covered by the Contract, the City, in addition to such other rights as may be afforded it under this Contract, shall withhold from the Contractor, out of any payments due the Contractor, so much thereof as the City, may consider necessary to pay such laborers or mechanics the full amount of wages required of this Contract. The amount so withheld may be disbursed by the City for and on account of the Contractor or the Subcontractor (as may be appropriate), to the respective laborers and mechanics to whom same is due or on their behalf to plans, funds, or programs for any type of fringe benefit prescribed in the applicable wage determination.

58. EMPLOYMENT OF CERTAIN PERSONS PROHIBITED

No person under the age of sixteen (16) years and no person who, at the time, is serving sentence in a penal, correctional institution or undocumented workers shall be employed on the Work covered by this Contract.

59. EMPLOYMENT OF LABORERS OR MECHANICS NOT LISTED IN AFORESAID WAGE DETERMINATION DECISION

Unlisted classifications needed for work not included within the scope of the classifications listed in the wage determination of this Contract maybe added after award only as provided in the labor standards contract clauses (29CFR, 5.5(a)(1)(ii).

60. FRINGE BENEFITS NOT EXPRESSED AS HOURLY WAGE RATES

The City shall require, whenever the minimum wage rate prescribed in the Contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly wage rate and the Contractor is obligated to pay cash equivalent of such benefit, an hourly cash equivalent thereof established. In the event the interested parties cannot agree upon a cash equivalent of the fringe benefits, the question, accompanied by a recommendation of the City, shall be referred to the Secretary of Housing and Urban Development, to the Secretary of Labor for determination.

61. POSTING WAGE DETERMINATION DECISIONS AND AUTHORIZED WAGE DEDUCTIONS

The applicable wage poster and the applicable wage determination decisions, with respect to the various classification of laborers and mechanic employed upon the Work covered by this Contract, and a statement showing all deductions, if any, in accordance with the provisions of this Contract, to be made from wages actually earned by persons so employed or to be employed in such classifications, shall be posted at the appropriate conspicuous points at the site of the Work.

62. COMPLAINTS, PROCEEDINGS, OR TESTIMONY BY EMPLOYEES

No laborer or mechanic to whom wages, salary or other labor standards provisions of this Contract are applicable shall be discharged or in any manner discriminated against by the Contractor or any Subcontractor because such employee has filed any complaint or instituted or caused to be instituted any proceeding or has testified or is about to testify in any proceeding under or relating to the labor standards applicable under this Contract to their employer.

63. CLAIMS AND DISPUTES PERTAINING TO WAGE RATES

Claims and disputes pertaining to wage rates or to classifications of laborers and mechanics employed upon the Work covered by this Contract shall be promptly reported by the Contractor in writing to the City for referral by the latter through the Secretary of Housing and Urban Development to the Secretary of Labor, United States Department of Labor, whose decision shall be final with respect thereto.

64. PAYROLLS AND BASIC PAYROLL RECORDS OF THE CONTRACTOR AND THE SUBCONTRACTOR

- A. The Contractor and each Subcontractor shall prepare their payrolls on forms satisfactory to and in accordance with instructions to be furnished by the City. The Contractor shall submit weekly to the City one (1) certified copy of all payrolls of the Contractor and of the subcontractors, it is being understood that the Contractor shall be responsible for the submission of copies of payrolls of all subcontractors. Each payroll shall contain the "Weekly Statement of Compliance" set forth in Section 3.3 of Title 29, Code of Federal Regulations. The payrolls and basic payroll records of the Contractor and each Subcontractor covering all laborers and mechanics employed upon the Work covered by this Contract shall be maintained during the course of the Work and for a period of three (3) years thereafter. Such payroll records

shall contain name and address of each employee, the employee's correct classification, rate of pay (including rates of contributions or costs anticipated of types described in Section 1(b)(2) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid.

- B. In addition, whenever the Secretary of Labor has found, under Section 5.5(a)(1)(iv) of Title 29, Code of Federal Regulations, that wages of any laborer or mechanic include the amount any costs reasonably anticipated in providing benefits under a plan, or program described in Section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor or Subcontractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible and that the plan or program has been communicated in writing to the laborers or mechanics affected, and will maintain records which show the costs anticipated or the actual cost incurred in providing such benefits. The Contractor and each Subcontractor shall make their employment records, with respect to persons employed by them upon the Work covered by this Contract, available for inspection by authorized representatives of the Secretary of Housing and Urban Development, the City and the United States Department of Labor. Such representatives shall be permitted to interview employees of the Contractor or of any subcontractors during working hours on the job.
- C. At a minimum the Contractor and subcontractors shall certify their payroll and remit such certification with the progress payment request.
65. **SPECIFIC COVERAGE OF CERTAIN TYPES OF WORK BY EMPLOYEES**
The transporting of materials and supplies to or from the site of the project or program to which the Contract pertains by the employees of the Contractor or any Subcontractor and manufacturing or furnishing of materials, articles, supplies or equipment on the site of the project of program to which this Contract pertains by persons employed by the Contractor or by any Subcontractor, shall, for the purpose of this Contract, and without limiting the generality of the foregoing provisions of this Contract, shall be deemed to be work which these Federal Labor Standards Provisions are applicable.
66. **INELIGIBLE SUBCONTRACTORS**
The Contractor shall not subcontract any part of the Work covered by this Contract or permit subcontracted work to be further subcontracted without the City's prior written approval of the Subcontractor. The City shall not approve any Subcontractor for work covered by this Contract who is at the time ineligible under the provisions of any applicable regulations issued by the Secretary of Labor, United States Department of Labor, or the Secretary of Housing and Urban Development to receive an award of such subcontract.

Any Subcontractor shall also not be eligible if they previously or currently, in default of a contract on any other project, have failed to complete any project or was removed from a project for defective work.

67. PROVISIONS TO BE INCLUDED IN CERTAIN SUBCONTRACTS

The Contractor shall include or cause to be included in each subcontract covering any of the Work covered by this Contract, provisions which are consistent with these Federal Labor Standards Provisions and also a clause requiring the Subcontractors to include such provisions in any lower tier subcontracts which they may enter into, together with a clause requiring such insertion in any further subcontracts that may be in turn be made.

68. BREACH OF FEDERAL LABOR STANDARDS PROVISIONS

In addition to the causes for termination of this Contract as herein set forth, the City reserves the right to terminate this Contract if the Contractor or any Subcontractor, whose subcontract covers any of the Work covered by this Contract, shall breach any of these Federal Labor Standards Provisions. A breach of these Federal Labor Standards Provisions may also be grounds for debarment as provided by the applicable regulations issued by the Secretary of Labor, United States Department of Labor.

69. EQUAL OPPORTUNITY PROVISIONS (E.O. 11246)

During the performance of this Contract, the Contractor agrees as follows:

- A. The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor shall take affirmative actions to ensure that applicants for employment are employed and that employees treated during employment without regard to their race, color, religion, sex, or national origin. Such action shall include, but not limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.
- B. The Contractor shall post in conspicuous places, available to employees and applicants for employment notice to be provided Contracting Officer setting forth provisions of this nondiscrimination clause.
- C. The Contractor shall state that all qualified applicants shall receive consideration for employment without regard to race, color, religion, sex, or national origin.
- D. The Contractor shall incorporate foregoing requirements in all subcontracts.

70. CIVIL RIGHTS ACT OF 1964

Under Chapter 106 of the Civil Practice & Remedies Code of the Revised Civil Statutes of Texas, no person shall, on the ground of race, color, national origin, sex, age, or handicap, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity of the City.

71. INDEMNIFICATION

- A. The Contractor shall defend, indemnify and hold harmless the City and the City's Design Professional and their respective officers, agents and employees, from and against all damages, claims, losses, demands, suits, judgments and costs, including reasonable attorney's fees and expenses

arising out of or resulting from the performance of the Work or any act or omission of the Contractor or the Contractor's employees, agents, suppliers or subcontractors.

- B. The obligation of the Contractor under this Paragraph shall not extend to the liability of the City's Design Professional, their agents or employees arising out of preparation or approval of maps, drawings, reports, surveys, Change Orders, designs or Technical Specifications, or the giving of or failure to give directions or instructions by the City's Design Professional, their agents or employees, provided such giving or failure to give is the primary cause of the injury or damage.

72. DELAYS

The Contractor shall receive no compensation for delays or hindrances to the Work, except when the direct or unavoidable extra cost to the Contractor is caused by failure of the City to provide information or material, if any, which is to be furnished by the City. When such extra compensation is claimed, a written statement thereof shall be presented by the Contractor to the City or the City's Design Professional and, if found correct, shall be referred to the City Council for final approval or disapproval; and action thereon by the City Council shall be final and binding. If delay is caused by specific orders given by the City or the City's Design Professional to stop work, or by the performance of extra work, or by the failure of the City to provide material or necessary instructions for carrying on the Work, then such a delay shall entitle the Contractor to an equivalent extension of time, the application of which shall, however, be subject to the approval or disapproval of the City Council; and no such extension of time shall release the Contractor or the Surety on their performance bond from all obligations hereunder which shall remain in full force until the discharge of the Contract.

73. MAINTENANCE OF WORK

If, after approval of Final Payment and prior to expiration of the one (1) year date of Substantial Completion or such longer period as may be prescribed by law or any applicable special guarantee required by the Contract Documents, any work is found to be defective, the Contractor shall promptly, without cost to the City and in accordance with the City's written instructions, correct such defective work. If the Contractor does not promptly comply with such instructions, the City shall have defective work corrected and all direct and indirect costs of such removal and replacement, including compensation for additional professional services, shall be paid by the Contractor or the Contractor's Surety. The provisions of this paragraph shall not limit the obligation of the Contractor under Paragraph 15 (Guarantee of Work) of the General Conditions in any respect whatsoever, including the time period of such Guarantee of Work contained therein, as will arise under the laws of the State of Texas and said Paragraph 15 and without regard to the provisions of this Paragraph, nor shall this Paragraph be construed to establish any period of limitations for any cause of action against the Contractor under the obligations of said Paragraph 15.

74. ANTITRUST

The Contractor hereby assigns to the City any and all claims for overcharges associated with this Contract which arise under the anti-trust laws of the United States, 15 U.S.C.A. Sec. 1, et seq. (1973).

75. DELAY, DISRUPTION, OR OTHER CLAIMS

Any claim by the Contractor for delay, disruption or any other claim shall be based on a written notice delivered to the City and to the City's Design Professional promptly (but in no case later than ten (10) working days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Within ten (10) working days of delivering said notice, the Contractor shall deliver to the City and the City's Design Professional notice of the amount of the claim and specific and detailed support documentation and data on the impact claimed. Further, the Contractor shall furnish on a continuing basis all of the documents that in any way are purported to support the damages, costs, expenses, and impact of the claim event. The Contractor's failure to fully comply with any of these requirements with respect to any claim shall constitute a complete and final waiver of said claim.

76. SANITARY AND SAFETY FACILITIES

The Contractor shall be responsible for all sanitary and safety facilities necessary for the Project, including rest rooms, drinking facilities, wash areas, hardhats, trench shoring, etc.

77. SUBMITTALS

The Contractor shall be responsible for verifying that all submittals from the suppliers, manufacturers, subcontractors, and/or any other source of materials, processes, services, equipment, hardware, and/or software, conform to the Contract Documents and Technical Specifications. **ANY AND ALL** deviations, no matter how minor, shall be listed on the Contractor Submittal sheet and identified on the submittals/shop drawings. Failure to acknowledge deviations from the Contract Documents and Technical Specifications, even if noted "Acknowledged Receipt", "No Exception", or "Exceptions As Noted", by either the City or the City's Design Professional, does not alleviate the responsibility and such submittal shall be deemed be Defective Work and shall be corrected according to the Specified Item at no additional charge to the City.

78. WARRANTIES

All warranties and guarantees for all material, labor, equipment, processes, services, hardware, and/or software shall begin at the time that the Project is accepted by the Friendswood City Council, and not at the time of purchase, installation, startup, manufacture, or creation date. Warranties and guarantees shall be for the length of time as stated in the Contract Documents and Technical Specifications, and not that of the supplier, manufacturer, creator, or subcontractor, and shall **NOT** be changed unless authorized by a Change Order approved and signed by the City. Any disparity between the Contractor and the supplier, manufacturer, and /or creator's Warranty Period and the Warranty Period

as stated in the Contract Documents and Technical Specifications, it shall be the Contractors responsibility to fix, repair or replace damaged/defective items for the duration of the One-Year Maintenance Period at no additional cost to the City.

END OF SECTION

PRE-CONSTRUCTION MEETING CHECKLIST

LIFT STATION NO. 2 REHABILITATION

1. Check availability of Contractor and reserve a room. ☐
3. Invite Director of Public Works (If Applicable). ☐
4. Invite Storm Water Coordinator (If Applicable). ☐
5. Invite Superintendent of Streets & Drainage (If Applicable). ☐
6. Invite Superintendent of Water & Sewer (If Applicable). ☐
7. Invite Plant Manager – Water Plant Operations (If Applicable). ☐
8. Invite Police Department (If Applicable). ☐
9. Invite Fire Marshal (If Applicable). ☐
10. Invite FISD Transportation (If Applicable). ☐
11. Invite the Engineering Representative ☐
12. Invite the Testing Firm Representative ☐
13. Invite Utility Companies ☐
 - A. TNMP Representative ☐
 - B. Centerpoint Representative ☐
 - C. ATT Representative ☐
 - D. Pipeline Representative(s) (If Applicable) ☐
14. Prepare Pre-Construction Meeting Outline and Sign In Sheet. ☐
15. Generate Notice to Proceed. ☐
17. Bring Final Construction Plan Set. ☐

END OF DOCUMENT

PRE-CONSTRUCTION MEETING OUTLINE (CITY PROJECT)

Project Name: Lift Station No.2 Rehabilitation

Date: [INSERT MEETING DATE]

Time: [INSERT MEETING TIME]

<u>Item</u>	<u>Discussed</u>
1. Set out Sign-in sheet.	☐
2. Introductions.	☐
3. Advise Contractor of testing lab. ([INSERT TESTING LAB NAME]).	☐
4. Notice to Proceed: Date on Letter: [INSERT DATE OF NTP] Beginning Date: [INSERT DATE TO START TIME] Completion Date: [INSERT ESTIMATED COMPLETION DATE]	☐
5. Contract is [INSERT # OF DAYS] [INSERT WORKING OR CALENDAR] Days Working Day is from 7 AM to 8 PM, Monday through Friday. This is based on noise ordinance, under 58 decibels 8PM to 7AM. No Weekend work unless approved by City Engineer.	☐
6. Construction Schedule/discuss time extension request forms	☐
7. Communication Channels A. All inspection requests shall be directed to the Community Development Department Permit Office at (281) 996-3201. B. Any requests to work weekends, design conflicts, etc. shall be directed to the City Engineer.	☐
8. Emergency Phone Numbers.	☐
9. Advise Contractor of responsibility to maintain a superintendent on job.	☐
11. Will Contractor have office on job? If so does location meet Owner's approval? Discuss Location.	☐
12. Permits are Contractors Responsibility.	☐
13. Pre-Construction Photographs are suggested.	☐
14. Safety Practice & Accident Reports.	☐
15. Staking is Contractor's Responsibility.	☐
16. Protection of adjoining property.	☐
17. Turn over to Stormwater Management Coordinator.	☐

- 18. Shop Drawings/Submittals to Engineer of Record, copy Project Manager. ☐
- 19. Change Orders. Procedures and forms. ☐
No work to be done prior to written approval.
- 20. Discuss Contractor Payment Application ☐
- 21. As-builts. ☐
- 22. Walkthroughs will not be scheduled until Project Manager ☐
feels that project is substantially completed.
- 23. Technical Specifications and Standard Details available online. ☐
<http://www.ci.friendswood.tx.us>
- 24. Confirm Sign-in sheet is complete and state that it will be shared via email. ☐
- 25. Schedule Progress Meetings. ☐
- 26. Questions/Contractor suggestions. ☐

END OF DOCUMENT

TIME EXTENSION REQUEST

Date: [INSERT DATE]

Project Name: Lift Station No.2 Rehabilitation

Project Number: [INSERT PROJECT NUMBER]

Attention: [INSERT CITY REP] Month of: [INSERT MONTH]

We request the extension of completion of time on our contract in the amount of [INSERT #DAYS] working days specified as follows:

1 __	2 __	3 __	4 __	5 __	6 __	7 __
8 __	9 __	10 __	11 __	12 __	13 __	14 __
15 __	16 __	17 __	18 __	19 __	20 __	21 __
22 __	23 __	24 __	25 __	26 __	27 __	28 __
29 __	30 __	31 __				

Please put an "X" in Saturday and Sunday Boxes. For Cold Weather enter "C", for Rain enter "R" and for Other enter "O" and add comments below.

—

[INSERT CONTACT NAME]
[INSERT CONTACT TITLE]

[INSERT CITY REPRESENTATIVE]
[INSERT TITLE]
City of Friendswood

Days Approved: _____

END OF DOCUMENT

WORK CHANGE DIRECTIVE (WCD)

WCD No.: WCD-[INSERT #]

PROJECT NAME: Lift Station No.2 Rehabilitation

PROJECT NUMBER: [INSERT PROJECT #]

TO: [INSERT CONTRACTOR CONTACT]
[INSERT CONTRACTOR NAME]
[INSERT ADDRESS]
[INSERT CITY, STATE, ZIP]

You are hereby directed to make the following changes in the Work, as described below and specified or shown on attachments, if applicable.

1.1 DESCRIPTION OF CHANGES:

- A. Brief description of changes in the Work:
[INSERT CHANGE DESCRIPTION]
- B. Justification for change(s):
[INSERT JUSTIFICATION]

1.2 PROPOSED ADJUSTMENTS:

- A. Contract Price (Check one):
 - ☐ Lump sum [INSERT INCREASE OR DECREASE] of \$.
 - ☐ Unit Price of \$[INSERT UNIT PRICE] per [INSERT UNIT].
 - ☐ As provided in subparagraph [INSERT PARAGRAPH #] of General Conditions.
 - ☐ As follows: [INSERT SPECIAL CONDITIONS].
- B. Contract Time: Contract Time is proposed to [INSERT BE ADJUSTED OR REMAIN THE SAME]. Proposed adjustment, if any, is [INSERT INCREASE OR DECREASE] of [INSERT # OF DAYS] working days.

1.3 NOTICE TO PROCEED BY THE CITY

Signature by City Manager indicates notice to proceed to Contractor for the described work and outlines proposed method of adjustment in Contract Price and Contract Time.

[INSERT YOUR NAME]
[INSERT YOUR TITLE]

Date

[INSERT DIRECTOR NAME]
Director of [INSERT YOUR DEPARTMENT]

Date

[INSERT CM NAME]
City Manager

Date

1.4 ACCEPTANCE BY CONTRACTOR

Signature by Contractor indicates Contractor's agreement with the above proposed adjustments in Contract Price and Contract Time.

[INSERT CONTACT NAME]
[INSERT CONTACT TITLE]

Date

END OF SECTION

CHANGE ORDER

CHANGE ORDER No.: CO-[INSERT #]

PROJECT NAME: Lift Station No.2 Rehabilitation

PROJECT NUMBER: [INSERT PROJECT #]

TO: [INSERT CONTRACTOR CONTACT]
[INSERT CONTRACTOR NAME]
[INSERT ADDRESS]
[INSERT CITY, STATE, ZIP]

Proposed Change:	Add	Deduct
	\$	\$
	\$	\$
	\$	\$
	\$	\$
	\$	\$
Request For Time Change		

Original Contract Amount:	\$_____	Original Contract Time:	_____
Net Previous Change Orders:	\$_____	Net Previous Time Changes:	_____
Total Contract Amount:	\$_____	Total Time Amount:	_____
This Change Order Amount Adds:	\$_____	This Change Order Time Adds:	_____
This Change Order Amount Deducts:	\$_____	This Change Order Time Deducts:	_____
New Contract Amount:	\$_____	New Contract Time:	_____

We, the undersigned, enter to agreement on the change of Contract Price and/or change in Contract Time.

[INSERT CONTRACTOR REP]
[INSERT TITLE]

Date

[INSERT CM NAME]
City Manager
City of Friendswood

Date

END OF DOCUMENT

00510-1

**CITY OF FRIENDSWOOD
TECHNICAL SPECIFICATIONS**

**CONTRACTOR
PAY APPLICATION**

Enter Contractor Name
Enter Contractor Address
Enter Contractor City, State and Zip Code
Enter Contractor Phone

Enter Project Name
Invoice Number
Date of Invoice
Pay Application #1

Line Item	Item Description	QTY	UNIT	Unit Price	Bid Amount	Quantities			Work Completed			Total Contract Balance	Work Percent Complete
						Prev.	Current	Total	Previous	Payments Current	Total to Date		
1	0	0	0	\$0.00	\$0.00	0		0	\$0.00	\$0.00	\$0.00	\$0.00	0.0%
2	0	0	0	\$0.00	\$0.00	0		0	\$0.00	\$0.00	\$0.00	\$0.00	0.0%
3	0	0	0	\$0.00	\$0.00	0		0	\$0.00	\$0.00	\$0.00	\$0.00	0.0%
4	0	0	0	\$0.00	\$0.00	0		0	\$0.00	\$0.00	\$0.00	\$0.00	0.0%
5	0	0	0	\$0.00	\$0.00	0		0	\$0.00	\$0.00	\$0.00	\$0.00	0.0%
6	0	0	0	\$0.00	\$0.00	0		0	\$0.00	\$0.00	\$0.00	\$0.00	0.0%
7	0	0	0	\$0.00	\$0.00	0		0	\$0.00	\$0.00	\$0.00	\$0.00	0.0%
8	0	0	0	\$0.00	\$0.00	0		0	\$0.00	\$0.00	\$0.00	\$0.00	0.0%
CO1	0	0	0	\$0.00	\$0.00	0		0	\$0.00	\$0.00	\$0.00	\$0.00	0.0%
CO2	0	0	0	\$0.00	\$0.00	0		0	\$0.00	\$0.00	\$0.00	\$0.00	0.0%
Retainage Held									\$0.00	\$0.00	\$0.00		
Totals:					\$0.00				\$0.00	\$0.00	\$0.00	\$0.00	#DIV/0!

CITY OF FRIENDSWOOD Enter Department Name Payment Authorization for Enter Project Name			
Project Number: Vendor Number: Purchase Order (PO) Number: Current PO Number (if rolled over):	Enter Project Number Enter Vendor Number Enter Purchase Order Number	Contractor: Address: City, State Zip: Phone Number:	Enter Contractor Name Enter Contractor Address Enter Contractor City, State and Zip Enter Contractor Phone
Invoice Number: Invoice Date: Pay Application Number: Amount Requested:	1 \$0.00		
Original Contract Amount: Approved Change Orders to Date: Current Contract Amount:	\$0.00 \$0.00 \$0.00		
Total Work Completed per this Invoice: Total Retainage Held per this Invoice: Total Previously Paid:	\$0.00 \$0.00 \$0.00		
Amount Recommended for Payment:	\$0.00		
Total Paid Inclusive of this Invoice: Total Retainage Inclusive of this Invoice: Total Funds Expended To Date: Remaining Contract Funds	\$0.00 \$0.00 \$0.00 \$0.00		

Prepared By:

 Name of Office Manager or Project Manager
 Office Manager or Project Manager

 Date

Reviewed By:

 Bria A. Whitmire, PE, CFM
 Projects Coordinator

 Date

Approved By:

 Jil Arias, PE, CFM
 Director of Engineering

 Date

PARTIAL WAIVER OF LIEN

STATE OF TEXAS §
COUNT OF GALVESTON §

For and in consideration of the receipt of [INSERT WRITTEN AMOUNT DUE] (\$[INSERT # AMOUNT]) is hereby acknowledged by [INSERT GENERAL CONTRACTOR NAME], does hereby waive and relinquish any and all claims and rights of lien to the extent of the amount hereon for the work, labor, materials, machinery or other goods, equipment or services done, performed or furnished in respect to invoice number [INSERT INVOICE #] billed to the City of Friendswood and located at [INSERT PROJECT ADDRESS] hereinafter described as: Lift Station No.2 Rehabilitation.

We, the undersigned, do by means of this instrument, affirm and confirm the face that there are no claims for labor, materials, or services outstanding against us on this project and on the contrary, all have been paid and otherwise discharged.

In witness wherefor, the undersigned has caused these present to be duly executed this the [INSERT DATE] day of [INSERT MONTH], [INSERT YEAR].

Name: [INSERT AUTHORIZED NAME]
Title: [INSERT THEIR TITLE]
Address: [INSERT ADDRESS]
 [INSERT CITY, STATE, ZIP]
Telephone: [INSERT TEL #]
EMAIL: [INSERT EMAIL]

Subscribed and sworn to before me this _____ day _____ of, _____.

Notary Public In and For the State of [INSERT STATE]

My Commission Expires: _____

END OF SECTION

FINAL WAIVER OF LIEN

STATE OF TEXAS §
COUNT OF GALVESTON §

For and in consideration of the receipt of [INSERT WRITTEN AMOUNT DUE] (\$[INSERT # AMOUNT]) is hereby acknowledged by [INSERT GENERAL CONTRACTOR NAME], does hereby waive and relinquish any and all claims and rights of lien to the extent of the amount hereon for the work, labor, materials, machinery or other goods, equipment or services done, performed or furnished in respect to invoice number [INSERT INVOICE #] billed to the City of Friendswood and located at [INSERT PROJECT ADDRESS] hereinafter described as: Lift Station No.2 Rehabilitation.

We, the undersigned, do by means of this instrument, affirm and confirm the face that there are no claims for labor, materials, or services outstanding against us on this project and on the contrary, all have been paid and otherwise discharged, including retainage.

In witness wherefor, the undersigned has caused these present to be duly executed this the [INSERT DATE] day of [INSERT MONTH], [INSERT YEAR].

Name: [INSERT AUTHORIZED NAME]
Title: [INSERT THEIR TITLE]
Address: [INSERT ADDRESS]
 [INSERT CITY, STATE, ZIP]
Telephone: [INSERT TEL #]
EMAIL: [INSERT EMAIL]

Subscribed and sworn to before me this _____ day _____ of, _____.

Notary Public In and For the State of [INSERT
STATE]

My Commission Expires: _____

END OF SECTION

NON-CONFORMANCE REPORT (NCR)

REPORT No.: NCR-[INSERT #]

PROJECT NAME: Lift Station No.2 Rehabilitation

PROJECT NUMBER: [INSERT PROJECT #]

TO: [INSERT CONTRACTOR CONTACT]
[INSERT CONTRACTOR NAME]
[INSERT ADDRESS]
[INSERT CITY, STATE, ZIP]

1.1 DESCRIPTION OF NONCONFORMANCE:
[INSERT DESCRIPTION OF NON-CONFORMANCE AND SPECIFIC
REFERNECES]

Reported by: [INSERT YOUR NAME]
Date Reported: [INSERT REPORT DATE]
Method of Notifying Contractor: [INSERT METHOD OF NOTIFICATION]
Date of Notification: [INSERT DATE OF NOTIFICATION]

1.2 DESCRIPTION OF CONFORMANCE:
[INSERT DESCRIPTION OF CONFORMANCE AND SPECIFIC REFERNECES]

Conformance shall be accomplished within seven (7) days after receipt of this notice and is to be coordinated with [INSERT YOUR TITLE]. If further information is needed, advise [INSERT YOUR TITLE] immediately. This non-conformance is considered an open item until resolved and accepted by the [INSERT YOUR TITLE].

1.3 ACKNOWLEDGEMENT

[INSERT CONTRACTOR REP]
[INSERT TITLE]

Date

[INSERT YOUR NAME]
[INSERT YOUR TITLE]

Date

END OF SECTION

FINAL WALKTHROUGH CHECKLIST

PART I: GENERAL HOUSEKEEPING

- 1.1 All trash, concrete wash out, concrete spillage, and debris has been removed from the site.
- 1.2 Streets have been cleaned and are still clean.
- 1.3 Used or unused construction materials have been removed from the site.

PART II: SANITARY SEWER SYSTEM

- 2.1 All lid covers read City of Friendswood Sanitary Sewer as shown in the City of Friendswood Standard Details.
- 2.2 All lid covers must be clean and free of concrete.
- 2.3 All manhole elevation adjustment rings are grouted appropriately.
- 2.4 Manhole service entrance diameter is thirty-two (32) inches.
- 2.5 All manholes are clean - No debris or mud inside.
- 2.6 Any piping entering a manhole should be grouted watertight so there are no spaces between the pipe and the manhole.
- 2.7 Pipe connections to existing manholes must be cored – NOT chipped or broken.
- 2.8 Finish elevation of manhole cover shall be as stated in Adjusting Manholes, Inlets and Valves Boxes to Grade.
- 2.9 Manhole cover inflow protector is in place.
- 2.10 Service leads are installed and extend a minimum of one (1) foot above finished grade.
- 2.11 Curbs should be painted green at each manhole or service lead aligned with the centerline of that manhole or service lead as specified in Temporary Utility Identification Markings.
- 2.12 Service lead end cap to be completely painted green.
- 2.13 Temporary plug is removed at the point of connection to the existing system.

- 2.14 All manholes shall be opened during the final walkthrough.

PART III: STORM WATER SYSTEM

- 3.1 All lid covers must read City of Friendswood Storm Sewer as shown in the City of Friendswood Standard Details.
- 3.2 All lid covers must be clean and free of concrete.
- 3.3 All manholes or inlets must be grouted smooth on the interior.
- 3.4 All manholes are clean - No debris or mud inside - No standing water.
- 3.5 All inlets are clean - No debris or mud inside - No standing water.
- 3.6 All piping is clean - No debris or mud inside - No standing water.
- 3.7 All inlets must have silt fence protecting front of inlet from debris.
- 3.8 All formwork must be removed from manholes or inlets.
- 3.9 All lifting hook places shall be grouted so no metal is showing.
- 3.10 Pipe protrusions into manholes or inlets must be cut flush with the inner wall of the manhole or inlet and grouted smooth and watertight.
- 3.11 Drainage inverts must be installed within manholes and inlets.
- 3.12 All joint cracks must be grouted appropriately.
- 3.13 All inlet grates must be installed and should be unmarked.
- 3.14 All Inlets and manholes shall be opened during final walkthrough.

PART IV: POTABLE WATER SYSTEMS

- 4.1 All main valves at point of connection to existing system are open and operable.
- 4.2 All main valves within the newly installed system are open and operable.
- 4.3 All fire hydrant valves are open and operable.
- 4.4 All valve covers are free of concrete.

- 4.5 All valve covers are painted blue.
- 4.6 All valve cover boxes are encased in concrete per City of Friendswood Standard Details.
- 4.7 All valve cover boxes are Tyler type "A" valve boxes.
- 4.8 All valve cover boxes are a minimum of three (3) inches above finished grade unless they are contained within a poured sidewalk at the time of the walk through, then they should be painted blue and flush with the sidewalk surface – No trip hazard.
- 4.9 Curbs should be painted blue at each valve, fire hydrant, blow-off, or meter service lead aligned with the centerline of that valve, fire hydrant, blow-off, or meter service lead as specified in Utility Identification Markings.
- 4.10 All valves shall be turned during final walkthrough.

PART V: FIRE HYDRANTS

- 5.1 All fire hydrants must be either Mueller Centurion or American Darling per the City of Friendswood Technical Specifications.
- 5.2 All fire hydrants must be sandblasted, painted with the approved City of Friendswood colors, and audited as specified in Fire Hydrant Assemblies. The City of Friendswood will accept a letter from the audit firm acknowledging they are under contract to perform the work.
- 5.3 All fire hydrants are set at the proper elevation based upon the finished grade and meeting the twenty-two (22) inch clearance to open the steamer nozzle.
- 5.4 All fire hydrant valves are open.
- 5.5 All fire hydrant valve covers are Type "A" covers and are painted blue.
- 5.6 All pumper nozzles shall face the street.
- 5.7 Blue reflectorized raised pavement marker shall be offset eight (8) inches from the centerline on the side where fire hydrant is located. Reflectorized side shall face direction of traffic.
- 5.8 Fire hydrants to be flowed during the final walkthrough.

PART VI: WATER METER SERVICE CONNECTIONS

- 6.1 Proper number of meter service connections have been installed.
- 6.2 Meter service boxes are located within the right of way or easement.
- 6.3 Meter service boxes are located off the property line a minimum of nine (9) inches laterally for a minimum spread between services of eighteen (18) inches.
- 6.4 Meter service boxes are set a minimum of three (3) inches above grade and undamaged.
- 6.5 Corporation stop set with the shutoff in the vertical position for easy "T" handle access.
- 6.6 Services are to be flowed during the final walkthrough.
- 6.7 Service lead and stop set to a maximum depth of twelve (12) inches below finished grade.

PART VII: POLLUTION PREVENTIVE PROTECTION

- 7.1 Erosion control must be provided around perimeter of property.
- 7.2 Erosion control must be provided at the back of curb for all lots, islands, and reserves.
- 7.3 Erosion control measures must be in place at all swales, curb inlets, and area inlets.
- 7.4 All erosion control measures must be in good condition for the walk through.
- 7.5 Hydro-mulch or sod must be provided at the back of curb, reserves, detention pond, and any drainage areas.

PART VIII: PROPERTY

- 8.1 Lots must be staked with lot numbers at the right of way and back of the lot.
- 8.2 Back lot stakes must have elevation control marks to match the design elevations.
- 8.3 Reserves must be identified on lot staking where adjacent to lots.

- 8.4 Property pins must be in place at the right of way and back lots.
- 8.5 Lots must exhibit positive drainage to match the plan design.
- 8.6 Lots must be graded to finish grades per the plan design.

PART IX: DETENTION POND

- 9.1 Drainage slopes for detention areas shall not exceed 4:1 (Horizontal versus Vertical) per both HCFCD and GCCDD.
- 9.2 Open channel drainage swales shall not exceed 4:1 (Horizontal versus Vertical) per the HCFCD criteria.
- 9.3 Open channel drainage swales shall not exceed 3:1 (Horizontal versus Vertical) per the GCCDD criteria.
- 9.4 GCCDD approval of drainage and detention facilities is required prior to the City of Friendswood walk through in Galveston County.
- 9.5 HCFCD acknowledges the City of Friendswood as their approval authority at the time of the walk through unless the site outfalls directly into an HCFCD Facility.
- 9.6 Outfall structures are complete.
- 9.7 Pipe projections at the outfall structures must be cut flush with the face of the outfall structure and grouted smooth.

PART X: PAVING AND SIDEWALKS

- 10.1 Street paving must be free of cracks and defects as defined in the City of Friendswood Technical Specification Concrete Paving.
- 10.2 Concrete spillage must be removed from the street travel surface.
- 10.3 No surface defects such as name imprints, bike tracks, tire tracks, animal tracks, etc. will be accepted.
- 10.4 Curbs must be free of defects.
- 10.5 Joint sealants have been installed at all construction joints, saw joints, and inlet joints.

- 10.5 Sidewalks have been installed at all islands, detention areas, utility easements, and reserves where indicated on the approved sidewalk accessibility plan.
- 10.6 Sidewalks have been installed along major thoroughfares adjoining the new subdivision.
- 10.7 Wheel Chair Ramp access has been provided at all locations as shown on the sidewalk accessibility plan, the five (5) foot by (five (5) foot turn area at the back of the Wheel Chair Ramp is part of the Wheel Chair Ramp.
- 10.8 Wheel Chair Ramps shall have the integral charcoal color per City of Friendswood Colored Concrete for Wheelchair Ramps.
- 10.9 Traffic control signage has been installed per City of Friendswood Standard Details.
- 10.10 The City of Friendswood and a lab representative must be present to witness each and every concrete placement.
- 10.11 Pavement markings are installed per the plans for traffic control islands, medians, turn lanes, and crosswalks.
- 10.12 Raised reflective blue and white pavement markers have been installed near the street centerline at each fire hydrant.

PART XI: TESTING

- 11.1 The City of Friendswood must be copied directly on all lab results and should have all reports in hand prior to the scheduling of the walk through.
- 11.2 A City of Friendswood representative should have been present to witness all concrete placements.
- 11.3 A testing lab representative should have been present to witness all concrete placements.
- 11.4 All testing has been completed successfully
- 11.5 Bacteria Test – City of Friendswood representative on site to witness test.
- 11.6 Sanitary Sewer low-pressure air test, deflection test and manhole vacuum test – City of Friendswood representative on site to witness test.
- 11.7 Waterline Test waterline pressure test – City of Friendswood representative on site to witness test.

- 11.8 Lime Depth Check Test – City of Friendswood representative on site to witness test.
- 11.9 Density and gradation tests – City of Friendswood representative on site to witness all tests.
- 11.10 Twenty-eight (28) day concrete compressive strength test results have been received by the City of Friendswood and all results are satisfactory.
- 11.11 Twenty-eight (28) day concrete pavement cores or pre-placement form checks have been taken for thickness and all results are satisfactory.

PART XII: LIFT STATIONS

- 12.1 All lift stations shall be tested as specified in the City of Friendswood Technical Specification Sanitary Sewer Lift Stations prior to scheduling the final walkthrough.

PART XIII: AS-BUILT DRAWINGS

- 13.1 Electronic drawing files formatted in AutoCAD and contained on two (2) individual CD's.
- 13.2 One (1) black line copy in full size and one (1) black line copy in half size.
- 13.3 Reflect any and all deviations in the field versus the original design documents on the As-Built sets.
- 13.4 Incorporate any and all design revisions from the original design.
- 13.5 Stamped conspicuously as "As-Built Drawings".
- 13.6 Must be a reproducible Mylar.
- 13.7 Must include one (1) set of blue line drawings for the acceptance final walkthrough.

PART XIV: MAINTENANCE BOND

- 14.1 Maintenance bond must name the City of Friendswood as the bondholder, dated to commence on the date the Work is scheduled for City Council approval.
- 14.2 In Galveston County the GCCDD requires a maintenance bond independent of the City of Friendswood.

- 14.3 Must be for the full value of the infrastructure improvements including work performed through Change Order to the Original Contract.
- 14.4 A copy of the Original Contract and any Change Orders that would establish the value of the infrastructure improvements shall be submitted with the Maintenance Bond.

Note: This document is intended to assist in preparing for the acceptance walk through and is not intended to be a site specific Punch list.

END OF DOCUMENT

CERTIFICATE OF SUBSTANTIAL COMPLETION

Date: [INSERT DATE]

[INSERT CONTRACTOR NAME]
ATTN: [INSERT CONTRACTOR CONTACT]
[INSERT CONTRACTOR ADDRESS]
[INSERT CITY, STATE, ZIP]

RE: Project Name: Lift Station No.2 Rehabilitation
Project No.: [INSERT PROJECT #]
[INSERT RFQ, RFP or BID #]No.: [INSERT RFQ, RFP or BID #]

Dear [INSERT CONTRACTOR CONTACT]:

1.1 NOTIFICATION

On NOTIFICATION DATE Projects Division received notification that the Contractor wished to declare the Work of the above referenced project Substantially Complete.

1.2 INSPECTION

A site visit and inspection of the Work performed under this Contract was carried out on INSPECTION DATE by the City to ascertain the compliance of the Work with the Contract. The Date of Substantial Completion is hereby established as DATE OF SUBSTANTIAL COMPLETION. During this site visit a punch list of incomplete or non-conforming work was identified and agreed to by the City of Friendswood and the Contractor.

1.3 PUNCH LIST

The list of incomplete or outstanding items to be completed or corrected by the Contractor and verified by the Project Manager, (Document 00785 – Punch List) is attached hereto. The project shall not be considered complete until those items have been corrected or otherwise brought into compliance with the Contract and that correction is demonstrated to the City. Failure to include any items on such list shall not alter the responsibility of the Contractor to complete the Work in accordance with the Contract. The Contractor shall complete or correct the Work on the Punch List attached hereto within ten (10) working days from the date shown on the punch list generated on the date of the Substantial Completion walk-through.

1.4 WARRANTY PERIOD

However, with the issuance of this certificate, the project is considered and accepted as Substantially Complete and the Contractor's warranty period of one (1) year shall commence from the above Date of Substantial Completion, or as stated in the contract if different, shall begin as of the date of this Certificate.

00600-1

1.5 OCCUPANCY BY THE CITY

Substantial Completion of the Work entitles the City to take possession and make use of the Work and to conduct routine operations therein. Such operation by the City shall take precedence over all activities of the Contractor. The DEPARTMENT shall assume full possession of the Work at TIME on DATE. {or will not take possession until after Final Completion.}

1.6 TRANSITION OF RESPONSIBILITIES

The City and the Contractor agree that security, maintenance, heating, ventilating, air conditioning, utilities, damage to the Work, and provision of insurance, during the period after Substantial Completion and prior to Final Completion, transfer to the City. The Contractor shall remove all his locks from gates at this time. Entry to the site by the Contractor from this point forward shall be by means of scheduled appointment that shall be approved by the City's operations staff.

1.7 COORDINATION OF CORRECTIVE WORK

All corrective activities conducted by the Contractor, his forces, subcontractors, and suppliers, shall comply with the City's operational schedule and shall in no way interfere with, impinge, or prevent the City's use of the project or benefit from its service. Any corrective actions that may require temporary shut down of any part or component of the project shall be reported in writing, scheduled, and approved by the City's operational staff at least twenty-four (24) hours prior to conducting that work. A list of all the Contractor's personnel, suppliers, and subcontractors expected or required to enter the project site shall be furnished to the City's operations staff prior to the scheduled work beginning. No exceptions shall be made.

The Contractor shall contact the City's operations staff at (281) 996-EXT for scheduling all further work on the project. Projects Division retains administrative control of the contract and all questions regarding approval of corrective work or payment for that work shall be directed to same.

1.8 ACCEPTANCE BY THE CITY

[Printed Name]

Project Manager

Signature

Date

[Printed Name]

Director of Community Development

Signature

Date

[Printed Name]

City Manager

Signature

Date

END OF DOCUMENT

00600-2

PUNCH LIST

Date: [INSERT DATE]

[INSERT CONTRACTOR NAME]
ATTN: [INSERT CONTRACTOR CONTACT]
[INSERT CONTRACTOR ADDRESS]
[INSERT CITY, STATE, ZIP]

RE: Project Name: Lift Station No.2 Rehabilitation
Project No.: [INSERT PROJECT #]
[INSERT RFQ, RFP or BID #]No.: [INSERT RFQ, RFP or BID #]

Dear [INSERT CONTRACTOR CONTACT]:

At the Substantial Completion walk-through on [INSERT SUBSTANTIAL COMPLETION DATE], the following items were discussed and need to be completed or corrected before a Final walk-through will be scheduled. The Project Manager shall conduct the Final walk-through and verify that all Items have been either completed or corrected. All necessary work shall be completed within ten (10) working days from the date shown on this notice.

<u>ITEM</u> <u>NO.</u>	<u>ITEM</u> <u>DESCRIPTION</u>	<u>DATE</u> <u>COMPLETED</u>

[INSERT YOUR NAME]
[INSERT YOUR TITLE]
City of Friendswood

END OF DOCUMENT

**AFFIDAVIT OF PAYMENT TO
SUBCONTRACTORS AND SUPPLIERS**

The undersigned, [INSERT SUBCONTRACTOR], states that they are the [INSERT TYPE OF WORK], of [INSERT CONTRACTOR NAME] and that he is duly authorized to execute this Certification of Payment to the Subcontractors and the Suppliers; that he swears and subscribes that the Contractor has made payments to the Subcontractors and the Suppliers for all labor, materials, equipment, and services furnished to date for the Work on Project No. [INSERT PROJECT #] in the amounts for which the Contractor has been paid; that the labor, materials, equipment, and services covered by this Certificate of Payment have been furnished in accordance with and all in compliance with the Contract Documents; that no sums have been withheld by the Contractor for the Subcontractors and the Suppliers as a result of any allegations of deficiencies in the Work; and further that such payments were made in accordance with the Contract Documents and with the laws of the State of Texas.

Affiant's Signature

SWORN AND SUBSCRIBED before me on _____
Date

Notary Public in and for the State of [INSERT STATE]

Print or type name

My Commission Expires: _____
Expiration Date

END OF DOCUMENT

DOCUMENT 00615

CONTRACTOR'S CERTIFICATION OF FINAL COMPLETION

PROJECT NAME: Lift Station No.2 Rehabilitation

PROJECT NUMBER: INSERT PROJECT NUMBER]

[INSERT BID, CSP, RFP] No.: INSERT BID, CSP OR RFP NUMBER

CONTRACT DATED: [INSERT CONTRACT DATE]

BEFORE ME, the undersigned authority, a Notary Public in and for the State of Texas, on this day personally appeared [INSERT PRINCIPAL NAME] who, being by me duly sworn, on his oath says that he or she represents [INSERT CONTRACTOR COMPANY], the Contractor who has performed a contract with the City of Friendswood for the construction of the Work described above, and is duly authorized to make this affidavit; that he or she has personally examined the Work described above as required by the Contract Documents; that said Work and all items thereof have been completed and all known defects made good; that all surplus material, refuse, dirt and rubbish have been cleaned up and removed or disposed of as directed by the [INSERT YOUR TITLE]; that all parts of Work are in a neat, tidy, finished condition and ready in all respects for acceptance by the City; that all gravel or shell roadway surfaces removed during the course of the Work have been replaced in accordance with the City of Friendswood Technical Specifications, that rates of pay for all labor employed on said Work have not been below the minimum set out in "Labor Classification and Minimum Wage Scale" in the Contract Documents and that within the knowledge of affiant all just bills for labor and material and for the rental or use of any equipment or apparatus, used in, on, or in connection with the Work have been paid in full by the Contractor.

Affiant's Signature

SWORN AND SUBSCRIBED before me on _____

Date

Notary Public in and for the State of
[INSERT STATE]

Print or type name

My Commission Expires: _____

Expiration Date

THIS IS TO CERTIFY that I have thoroughly inspected the Work performed by the above named Contractor on the above described Contract and find all things in accordance with the Contract documents governing this Work.

[INSERT YOUR NAME]
[INSERT YOUR TITLE]
City of Friendswood

Date

END OF DOCUMENT

NOTICE OF FINAL COMPLETION

PROJECT NAME: Lift Station No.2 Rehabilitation

PROJECT NUMBER: [INSERT PROJECT #]

CSP NUMBER: [INSERT BID, CSP OR RFP #]

1.1 DATE OF FINAL COMPLETION

On [INSERT DATE] the [INSERT YOUR DEPARTMENT] received notification that the Contractor, [INSERT CONTRACTOR NAME], wished to declare the Work on the above referenced project being complete and all the Work being acceptable to the City.

A site visit was carried out on [INSERT DATE] by the City to ascertain the compliance of the Work with the Contract for Substantial Completion. During that site visit, a punch list of incomplete or non-conforming work was identified and agreed to by the City and the Contractor.

1.2 PUNCH LIST

Contractor certified in Contractor's Certification of Final Completion that all Punch List items were completed or corrected.

The [INSERT YOUR TITLE] scheduled a review of punch list items on [INSERT DATE] and the project is now considered to be complete since those items on the punch list have been corrected or otherwise brought into compliance with the Contract and that such correction has been demonstrated to the City.

Failure by the City to identify incomplete work items or requirements of the Contract prior to issuance of this Certificate shall not relieve the Contractor of the responsibility to comply with all provisions of the Contract.

1.3 ONE-YEAR MAINTENANCE PERIOD

With the issuance of this Notice, the project is considered and accepted as Final and that the Contractor's warranty period of one (1) year began on the date of Final Completion, or as stated in the contract if different, and shall remain in effect until [INSERT COUNCIL DATE]. The Contractor shall provide the City with a One-Year Maintenance Bond in the amount of \$[INSERT CONTRACT AMOUNT] to secure this warranty. All corrective activities conducted by the Contractor, his forces, subcontractors, and suppliers under the One-Year Maintenance period, shall comply with the City's operational schedule and shall in no way interfere with, impinge, or prevent the City's use of the project or benefit from its service. Any corrective actions that may require temporary shut down of any part or component of the project shall be reported in writing, scheduled, and approved by the City's operational staff at least twenty-four (24) hours prior to conducting that work.

At the end of the One-Year Maintenance Period, it is incumbent on the Contractor to contact the City to schedule a One-Year Maintenance walk-through. At that time, a list of deficient items shall be given to the Contractor who shall remedy the items in an expeditious manner. The One-Year Maintenance Bond shall be written so as to remain in effect until completion of all items and a Certificate of One-Year Maintenance Acceptance is issued to the Contractor and to the bonding company.

Contractor shall contact the City's operations staff at 281-[INSERT DEPT MAIN#] for scheduling any corrective or warranty work on the project. The [INSERT YOUR DEPARTMENT] retains administrative control of the project and all questions regarding approval of corrective work or payment for that work shall be directed to 281-[INSERT PHONE NUMBER].

1.4 ACCEPTANCE OF THE WORK

Based on inspection and to the best of our knowledge, information and belief, the Work has been completed in accordance with the terms and conditions of the Contract and we recommend acceptance of the Work by City Council.

Notwithstanding the City's acceptance of the Work, nothing herein shall serve to waive or otherwise extinguish any outstanding claims on the City's part for recovery of Liquidated Damages pursuant to Article IV of the Contract, all such claims being hereby reserved.

1.5 RECOMMENDATION BY STAFF

[INSERT YOUR NAME]
[INSERT YOUR TITLE]
City of Friendswood

Date

[INSERT DIR NAME]
Director of [INSERT DEPARTMENT]
City of Friendswood

Date

[INSERT CM NAME]
City Manager
City of Friendswood

Date

1.6 ACCEPTANCE OF PROJECT

Notice was given to the City Council of the recommendation by City Staff to accept [INSERT PROJECT NAME] as final and complete. The City Council on INSERT COUNCIL DATE] voted to accept the Work; the Project is hereby deemed final and complete; and authorizes the Mayor to sign this Notice of Final Completion as acceptance of the above listed Project.

[INSERT MAYOR'S NAME]
Mayor
City of Friendswood

DATE

ATTEST:

[INSERT CITY SECRETARY'S NAME]
City Secretary
City of Friendswood

DATE

END OF DOCUMENT

ONE-YEAR MAINTENANCE BOND

THAT WE, [INSERT CONTRACTOR NAME], as Principal, hereinafter called the Contractor, and the other subscriber hereto, [INSERT SURETY NAME], as the Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Friendswood, a municipal corporation, in the sum of [INSERT WRITTEN DOLLAR AMOUNT] dollars and [INSERT WRITTEN CENTS AMOUNT] cents (\$[INSERT NUMBERS]), for the payment of which sum well and truly to be made to the City of Friendswood and its successors, the said Contractor and Surety do bind themselves, their heirs, executors, administrators, successors, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a Contract in writing with the City of Friendswood for [INSERT INSTALLATION OR CONSTRUCTION] of Lift Station No.2 Rehabilitation, all of such work to be done as set out in full in said Contract Documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein; and, whereas, certain work was found to be defective at the end of the One-year Maintenance period;

NOW THEREFORE, if the said Contractor shall comply with the provisions of the General Conditions, and correct work not in accordance with the Contract Documents discovered within the established one-year period, then this obligation shall become null and void, and shall be of no further force and effect; otherwise, the same is to remain in full force and effect.

Notices required or permitted hereunder shall be in writing and shall be deemed delivered when actually received or, if earlier, on the third (3rd) day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other party at the address prescribed in the Contract Documents, or at such other address as the receiving party may hereafter prescribe by written notice to the sending party.

PROVIDED FURTHER, that if any legal action be filed upon this Bond, venue shall lie in Galveston County, Texas.

IN WITNESS THEREOF, the Bidder and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

Principal/Contractor

Surety

By:_____

By: _____
(Attorney-in-Fact Signature)

Printed Name:_____

Printed Name:_____

Address:_____

Address:_____

ATTEST:

ATTEST:

Secretary (if corporation)/Witness

Secretary (if corporation)/Witness

[Corporate Seal if corporation]

[Surety Seal]

Registered Agent of Surety for Delivery
of notice and service of process:

Name: _____

Address:_____

Phone Number:_____

**NOTE: Attach Certified Copy of Power of Attorney
END OF DOCUMENT**

EXTENDED WARRANTY MAINTENANCE BOND

THAT WE, [INSERT CONTRACTOR NAME], as Principal, hereinafter called the Contractor, and the other subscriber hereto, [INSERT SURETY NAME], as the Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Friendswood, a municipal corporation, in the sum of [INSERT WRITTEN DOLLAR AMOUNT] dollars and [INSERT WRITTEN CENTS AMOUNT] cents (\$[INSERT NUMBERS]), for the payment of which sum well and truly to be made to the City of Friendswood and its successors, the said Contractor and Surety do bind themselves, their heirs, executors, administrators, successors, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a Contract in writing with the City of Friendswood for [INSERT INSTALLATION OR CONSTRUCTION] of Lift Station No.2 Rehabilitation, all of such work to be done as set out in full in said Contract Documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein; and, whereas, certain work was found to be defective at the end of the One-year Maintenance period;

NOW THEREFORE, if the said Contractor shall comply with the Correction of Work provision of the General Conditions, and warrant work not in accordance with the Contract Documents discovered within [INSERT ADDITIONAL WARRANTY PERIOD] from the date that the One-year Maintenance Bond has expired, then this obligation shall become null and void, and shall be of no further force and effect; otherwise, the same is to remain in full force and effect.

Notices required or permitted hereunder shall be in writing and shall be deemed delivered when actually received or, if earlier, on the third (3rd) day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other party at the address prescribed in the Contract Documents, or at such other address as the receiving party may hereafter prescribe by written notice to the sending party.

PROVIDED FURTHER, that if any legal action be filed upon this Bond, venue shall lie in Galveston County, Texas.

IN WITNESS THEREOF, the Bidder and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

Principal/Contractor

Surety

By:_____

By: _____
(Attorney-in-Fact Signature)

Printed Name:_____

Printed Name:_____

Address:_____

Address:_____

ATTEST:

ATTEST:

Secretary (if corporation)/Witness

Secretary (if corporation)/Witness

[Corporate Seal if corporation]

[Surety Seal]

Registered Agent of Surety for Delivery
of notice and service of process:

Name: _____

Address:_____

Phone Number:_____

**NOTE: Attach Certified Copy of Power of Attorney
END OF DOCUMENT**

CERTIFICATE OF ONE-YEAR MAINTENANCE ACCEPTANCE

PROJECT NAME: Lift Station No.2 Rehabilitation

PROJECT NUMBER: [INSERT PROJECT #]

[INSERT BID, CSP OR RFP] NUMBER: [INSERT BID, CSP OR RFP #]

On [INSERT NOTIFICATION DATE] the [INSERT YOUR DEPARTMENT] received notification that the Contractor wished to declare the One-Year Maintenance Period of the Work on the above referenced project was coming to completion. A site visit was requested to inspect the Work for release of the One-Year Maintenance Bond.

A site visit was carried out on [INSERT SUBSTANTIAL COMPLETION DATE] by the City to ascertain the compliance of the Work with the Contract for Substantial Completion. During that site visit, a punch list of incomplete or non-conforming work was identified and agreed to by the City and the [INSERT CONTRACTOR NAME]. All work is declared Acceptable and the One-year Maintenance Period is complete and accepted by the City Council on [INSERT COUNCIL DATE].

This Certificate acknowledges that the Contractor has fulfilled all of the requirements of the Contract with the City of Friendswood and both the City and the Contractor considers this Contract complete. It dissolves any claim from either the Contractor or the City pertaining to any part of this Contract, except for Manufacturer's Warranties that extend past the One-Year Maintenance Period in which any problems will be dealt with between the City and the Manufacturer.

[INSERT YOUR NAME]
[INSERT YOUR TITLE]

Date

END OF DOCUMENT

**CERTIFICATE OF EXTENDED WARRANTY
MAINTENANCE ACCEPTANCE**

PROJECT NAME: Lift Station No.2 Rehabilitation

PROJECT NUMBER: [INSERT PROJECT #]

[INSERT BID, CSP OR RFP] NUMBER: [INSERT BID, CSP OR RFP #]

On [INSERT NOTIFICATION DATE] the [INSERT YOUR DEPARTMENT] received notification that the Contractor wished to declare the [INSERT AMOUNT OF TIME FOR EXTENDED WARRANTY] Extended Warranty Maintenance Period of the Work on the above referenced project was coming to completion. A site visit was requested to inspect the Work for release of the [INSERT AMOUNT OF TIME FOR EXTENDED WARRANTY] Extended Maintenance Bond.

A site visit was carried out on [INSERT INSPECTION DATE] by the City to ascertain the compliance of the Work with the Contract for Substantial Completion. During that site visit, a punch list of incomplete or non-conforming work was identified and agreed to by the City and the Contractor. The Contractor has, as of [INSERT DATE OF VERIFICATION], performed all necessary corrections. All work is declared Acceptable and [INSERT AMOUNT OF TIME FOR EXTENDED WARRANTY] Extended Maintenance Period is complete and accepted by City Council on [INSERT COUNCIL DATE].

This Certificate acknowledges that the Contractor has fulfilled all of the requirements of the Contract with the City of Friendswood and both the City and the Contractor considers this Contract complete. It dissolves any claim from either the Contractor or the City pertaining to any part of this Contract, except for Manufacturer's Warranties that extend past the [INSERT AMOUNT OF TIME FOR EXTENDED WARRANTY] Extended Maintenance Period in which any problems will be dealt with between the City and the Manufacturer.

[INSERT YOUR NAME]
[INSERT YOUR TITLE]
City of Friendswood

Date

END OF DOCUMENT

RELEASE OF BOND

Date: [INSERT DATE]
PROJECT NAME: Lift Station No.2 Rehabilitation
PROJECT NUMBER: [INSERT PROJECT #]

TO: [INSERT CONTRACTOR NAME]
[INSERT CONTRACTOR ADDRESS]
[INSERT CONTRACTOR CITY/STATE/ZIP CODE]

The Contractor and the Surety having complied with the provisions of the General Conditions, and all work is in accordance with the Contract Documents at the end of the [INSERT ONE-YEAR OR EXTENDED WARRANTY] This Project was brought before the City Council on [INSERT DATE] for the acceptance of the One-Year Maintenance Period. The City Council accepted the One-Year Maintenance as complete and renders this obligation null and void, releasing the [INSERT ONE-YEAR OR EXTENDED WARRANTY] Maintenance Bond, Bond Number [INSERT BOND NUMBER] from [INSERT BONDING COMPANY NAME], [INSERT BONDING COMPANY ADDRESS], [INSERT BONDING COMPANY CITY/STATE/ZC], which is enclosed.

[INSERT YOUR NAME]
[INSERT YOUR TITLE]

END OF DOCUMENT

SUBMITTAL PROCEDURES

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

A. Submittal procedures for:

1. Schedule of Values.
2. Construction Schedules and Cash Flow Curve (billing forecast).
3. Shop Drawings, Product Data and Samples.
4. Operations and Maintenance (O&M) Data.
5. Manufacturer's Certificates.
6. Construction Photographs.
7. Project Record Documents and monthly certification.
8. Video Media.
9. Design Mixes.

1.2 SUBMITTAL PROCEDURES

A. Scheduling and Handling:

1. Submit Shop Drawings, Product Data and Samples for related components as required by the Technical Specifications and the Project Manager.
2. Schedule submittals well in advance of need for construction Products. Allow time for delivery of Products after submittal approval.
3. Develop submittal schedule that allows sufficient time for initial review, correction, resubmission and final review of all submittals. Allow a minimum of thirty days (30 D) for initial review. The Project Manager will review and return submittals to the Contractor as expeditiously as possible but time required for review will vary depending on complexity and quantity of data submitted.
4. The Project Manager's review of submittals covers only general conformance to the Drawings, the Technical Specifications and dimensions that affect layout. The Contractor is responsible for quantity determination. No quantities will be verified by the Project Manager. The Contractor is responsible for errors, omissions or deviations from Contract Document requirements; review of submittals does not relieve the Contractor from the obligation to furnish required items in accordance with the Drawings and the Technical Specifications.
5. Submit two (2) copies of documents unless otherwise specified.
6. Revise and resubmit submittals as required. Identify all changes made since previous submittal.
7. Assume risk for fabricated Products delivered prior to approval. Do not incorporate Products into the Work, or include payment

- for Products in periodic progress payments, until approved by the Project Manager.
- B. Transmittal Form and Numbering:
1. Transmit each submittal to the Project Manager with Transmittal letter which includes:
 - a. Date and submittal number.
 - b. Project title and number.
 - c. Names of the Contractor, the Subcontractor, the Supplier and the Manufacturer.
 - d. Identification of Product being supplied.
 - e. Location of where Product is to be installed.
 - f. Applicable Technical Specification section number.
 2. Identify deviations from Contract Documents clouding submittal drawings. Itemize and detail on separate eight and one-half inch by eleven inch (8-1/2 In x 11 In) sheets entitled "DEVIATIONS FOR _____." When no deviations exist, submit a sheet stating no deviations exist.
 3. Have design deviations signed and sealed by an appropriate Professional Engineer licensed by the State of Texas.
 4. Sequentially number transmittal letters beginning with number one (1). Use original number for re-submittals with an alphabetic suffix [i.e., 2A for the first (1st) re-submittal of submittal 2, or 15C for third (3rd) re-submittal of submittal 15, etc.]. Show only one (1) type of work or Product on each submittal. Mixed submittals will not be accepted.
- C. The Contractor's Stamp:
1. Apply the Contractor's Stamp certifying that the items have been reviewed in detail by the Contractor and that they comply with Contract Document requirements, except as noted by requested variances.
 2. As a minimum, the Contractor's Stamp shall include:
 - a. The Contractor's name.
 - b. Job number.
 - c. Submittal number.
 - d. Certification statement the Contractor has reviewed submittal and it is in compliance with the Contract Documents and the Technical Specifications.
 - e. Signature line for the Contractor.
- D. Submittals will be returned with one (1) of the following Responses:
1. "ACKNOWLEDGE RECEIPT" when no response and re-submittal is required.
 2. "NO EXCEPTION" when sufficient information has supplied to determine that item described is accepted and that no re-submittal is required.
 3. "EXCEPTIONS AS NOTED" when sufficient information has been supplied to determine that item will be acceptable subject

to changes, or exceptions, which will be clearly stated. When exceptions require additional changes, the changes must be submitted for approval. Re-submittal is not required when exceptions require no further changes.

4. "REJECTED-RESUBMIT" when submittal does not contain sufficient information, or when information provided does not meet Contract Document requirements and the Technical Specifications. Additional data or details requested by the Project Manager must be submitted to obtain approval.

1.3 MANUFACTURER'S CERTIFICATES

- A. When required by the Technical Specification sections, submit manufacturers' certificate of compliance for review by the Project Manager.
- B. Place the Contractor's Stamp on front of certification.
- C. Submit supporting reference data, affidavits, and certifications as appropriate.
- D. Product certificates may be recent or from previous test results, but must be acceptable to the Project Manager.

1.4 DESIGN MIXES

- A. When required by the Technical Specification sections, submit design mixes for review.
- B. Place the Contractor's Stamp, as specified in this section, on the front of each design mix.
- C. Mark each mix to identify proportions, gradations, and additives for each class and type of mix submitted. Include applicable test results from samples for each mix. Perform tests and certifications within twelve months (12 Mo) of the date of the submittal.
- D. Maintain copies of approved mixes at mixing plant.

1.5 CHANGES TO THE CONTRACT

- A. Changes to the Contract may be initiated by completing a Request for Information form. The Project Manager will provide a response to the Contractor by completing the form and returning it to the Contractor.
 1. If the Contractor agrees that the response will result in no increase in cost or time, a Minor Change in the Work will be issued by the Project Manager.
 2. If the Contractor and the Project Manager agree that an increase in time or cost is warranted, the Project Manager will forward the Request for Proposal for negotiation of a Change Order.

PART II: PRODUCTS – NOT USED.

PART III: EXECUTION – NOT USED.

END OF SECTION

MEASUREMENT AND PAYMENT

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Procedures for measurement and payment plus conditions for nonconformance assessment and nonpayment for rejected products.

1.2 UNIT QUANTITIES SPECIFIED

- A. Quantity and measurement estimates stated in the Agreement are for contract purposes only. Quantities and measurements supplied or placed in the Work and verified by the Project Manager shall determine payment.
- B. When actual work requires greater or lesser quantities than those quantities indicated in the Unit Price Forms, provide required quantities as approved by the Project Manager at Unit Prices contracted.

1.3 APPLICATION FOR PROGRESS PAYMENT

- A. Progress payments shall be based on the Project Manager's observations and evaluations of quantities incorporated in the Work multiplied by Unit Price.
- B. Interim payments for stored materials shall be made only for materials to be incorporated under items covered in unit prices. Only material that is stored on-site and in quantities verified by the Project Manager shall be allowed for payment.
- C. Attach the following to each application in this order:
 - 1. Contractor Pay Application.
 - 2. Time Request, if applicable.
 - a. All weather request or delays due to acts outside of the Contractor's control shall be submitted on this document with each application for payment. Failure to do so during the period covered by the application shall result in no time being given at all. No Exceptions. Time shall not be accumulated and added at the end of the Contract.
 - 3. Progress Schedule, updated and current, indicating the progress through the period covered by the application and scheduled progress through completion of the Work.
- D. Payment for Change Orders shall be based the Project Manager's observation after change order work is completed. Any work started or completed on a change order that has not been approved shall not be applicable for payment.

1.4 APPLICATION FOR PAYMENT AFTER SUBSTANTIAL COMPLETION

- A. The Contractor shall request an inspection for substantial completion in

writing to the Project Manager.

- B. The Project Manager and other appropriate entities shall, on a date set by the Project Manager, review the Work. If all are in agreement that the Work is substantially complete, the Project Manager shall issue Certificate of Substantial Completion and Punch List.
- C. After the Contractor has received the Substantial Completion certificate, the Contractor shall submit application for payment with the following requirements:
 - 3. Reduction in retainage as allowed by Section 00500 – General Conditions.

1.5 APPLICATION FOR FINAL PAYMENT

- A. The Project Manager and the Contractor shall review all items listed on Document 00785 – Punch List and verify that all items are complete before executing the following steps for Final Application.
- B. Submit Document 00940 – Contractor Pay Application and Document 00945 – Contractor Pay Request with the following attached:
 - 1. Document 00790 – Contractors Certification of Final Completion.
 - 2. Document 00775 – Certification of Payment to Subcontractors and Suppliers.
 - 3. Document 00800 – One-Year Maintenance Bond.
 - 4. Document 00805 – Extended Warranty Maintenance Bond, if required.
 - 5. Final Balancing Change Order for any unused items.
 - 6. All Operation and Maintenance Manuals.
 - 7. All Project Record Documents as required by Section 01785 – Project Record Documents.
 - 8. As-built Drawings.
- C. The Project Manager, upon receipt of all documents in paragraph 1.5.B of this Section, shall schedule Final Acceptance at the next regular City Council meeting.
- D. Once the City Council has accepted the project, the Project Manager shall send the Contractor Document 00795 – Notice of Final Completion and release the Final Payment to the Contractor.

1.6 NONCONFORMANCE ASSESMENT

- A. Remove and replace work, or portions of the Work, not conforming to the Contract Documents.
- B. When not practical to remove or replace work, Director of Engineering shall direct one of the following remedies:
 - 1. Nonconforming work shall remain as is, but Unit Price shall be adjusted lower at the discretion of the Director of Engineering.
 - 2. Nonconforming work shall be modified as directed by the Director of Engineering and the Unit Price shall be adjusted lower at the discretion of the Director of Engineering, when

modified work is deemed less suitable than that originally specified.

- C. Specification sections may modify the above remedies or may identify a specific formula or percentage of price reduction.
- D. Authority of Director of Engineering to assess nonconforming work and identify payment adjustment is final.

1.7 NONPAYMENT FOR REJECTED PRODUCTS

- A. Payment shall not be made for any of the following:
 - 1. Products wasted or disposed of in an unacceptable manner.
 - 2. Products determined as nonconforming before, during or after placement.
 - 3. Products not completely unloaded from transporting vehicles.
 - 4. Products placed beyond lines and levels of required work.
 - 5. Products remaining on hand after completion of the Work, unless specified otherwise.
 - 6. Loading, hauling and disposing of rejected Products.
 - 7. Products, either new or existing, that were damaged by the Contractor or one (1) of the Contractors subs.

PART II: PRODUCTS – NOT USED.

PART III: EXECUTION – NOT USED.

END OF SECTION

CONTINGENCIES AND ALLOWANCES

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Schedule of monetary amounts of allowances in the Contract Sum for designated products or services.
- B. Costs in Contract Sum other than in Allowances.
- C. Administrative and procedural requirements governing the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost allowances.
 - 3. Quantity allowances.
 - 4. Contingency allowances.
 - 5. Testing and inspecting allowances.

1.2 SCHEDULE OF ALLOWANCES

- A. To be determined.

1.3 COSTS INCLUDED IN ALLOWANCES

- A. Cost of product to the Contractor or subcontractor, less applicable trade discounts.
- B. Delivery to site.
- C. Labor required under allowance, only when labor is specified to be included.

1.4 CONTRACTOR COSTS INCLUDED IN CONTRACT SUM

- A. Products handling at site, including unloading, uncrating, and storage.
- B. Protection of products from elements and from damage.
- C. Labor for installation and finishing, except when installation is specified as part of allowance.
- D. Other expenses required to complete installation.
- E. Contractor overhead and profit.

1.5 ADJUSTMENT OF COSTS

- A. Should the net cost be more or less than the specified amount of the allowance, the Contract Sum will be adjusted accordingly by Change Order.
- B. Submit claims for anticipated additional costs at the site, or other expenses caused by the selection under the allowance, prior to execution of the Work.
- C. Submit documentation for actual additional costs at the site, or other expenses caused by the selection under the allowance, prior to execution of the work.
- D. Failure to submit claims within the designated time will constitute a waiver of claims for additional costs.

1.6 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise the Project Manager of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At the Project Manager's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by the Project Manager from the designated supplier.

1.7 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.
- D. Schedule shop drawings, product data, samples, and delivery dates, in Progress Schedule for products selected under allowances.

1.8 COORDINATION

- A. Coordinate allowance items with other portions of the Work.
- B. Furnish templates as required to coordinate installation.

1.9 PROJECT MANAGER RESPONSIBILITIES

- A. Consult with the Contractor in consideration of products, suppliers, and installers.
- B. Select products and transmit full information in writing to the Contractor as follows:
 - 1. Manufacturer, product, model or catalog number, accessories, attachments, and finishes.
 - 2. Supplier and installer as applicable.
 - 3. Cost to Contractor, delivered to site, and installed, if so specified.

1.10 CONTRACTOR RESPONSIBILITIES

- A. Assist the Project Manager in determining suppliers and installers; obtain proposals when requested.
- B. Make recommendations for the Project Manager's consideration.
- C. Promptly notify the Project Manager of any reasonable objections against supplier or installer.
- D. On notification of selection, execute purchase agreement with designated supplier and installer.
- E. Arrange for and process shop drawings, product data, and samples.

- F. Arrange for delivery. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
- G. Install, adjust, and finish products.
- H. Provide warranties for products and installation.

1.11 CONTINGENCY ALLOWANCE

- A. Use the contingency allowance only as directed by the Project Manager for the City's purposes, and only by Change Orders which designate amounts to be charged to the allowance.
- B. The Contractor's related costs for products or equipment ordered by the City under the contingency allowance, including delivery, installation, taxes, insurance, equipment rental, and similar costs that are not part of the Contract Sum.
- C. Change Orders authorizing use of funds from the contingency allowance will not include the Contractor's related costs and reasonable overhead and profit margins. Contractor shall include in base bid, Contractor's overhead, profit, insurance, bond and other direct cost.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to City by Change Order or transfer the remaining amounts to other allowances as directed by the Project Manager.

1.12 INSPECTION AND TESTING ALLOWANCES

- A. Inspection and testing allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
- B. The allowance does not include incidental labor required to assist the testing agency, or costs for retesting upon failure of previous tests and inspections. The allowance also does not include costs of services not required by the Contract Documents. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.
- C. At Project closeout, credit unused amounts remaining in the inspection and testing allowance to City by Change Order.

1.13 UNUSED MATERIALS

- A. Return unused materials purchased under an allowance to manufacturer or supplier for credit to City, after installation has been completed and accepted.
 - 1. If requested by the Project Manager, prepare unused material for storage by the City when it is not economically practical to return the material for credit. If directed by the Project Manager, deliver unused material to the City's storage space. Otherwise, disposal of unused material is the Contractor's responsibility.
- B. Where it is not economically feasible to return unused material for credit and when requested by the Project Manager, prepare unused material

for the City's storage, and deliver to the City's storage space as directed. Otherwise, disposal of excess material is the Contractor's responsibility.

PART II: PRODUCTS – NOT USED.

PART III: EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

END OF SECTION

CHANGE ORDER PROCEDURES

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Procedures for processing Change Orders, including:
 - 1. Documentation of change in Contract Price and Contract Time;
 - 2. Execution of Change Orders;
 - 3. Correlation of Contractor submittals.

1.2 REFERENCES

- A. Blue Book is defined as the Rental Rate Blue Book for Construction Equipment (a.k.a. Data Quest Blue Book).
 - 1. Rental Rate is defined as the full-unadjusted base rental rate for the appropriate item of construction equipment.

1.3 DOCUMENTATION OF CHANGE IN THE CONTRACT PRICE AND THE CONTRACT TIME

- A. Maintain detailed records of changes in the Work. Provide full information required for identification and evaluation of proposed changes, and substantiate costs of changes in the Work.
- B. Document each proposal for change in the Contract Price or the Contract Time with sufficient data to allow evaluation of proposal.
- C. Include the following minimum information on proposals:
 - 1. Quantities of items in original Unit Price Form with additions, reductions, deletions, and substitutions.
 - 2. Quantities and cost of items in the original Schedule of Values with additions, reductions, deletions and substitutions.
 - 3. Provide Unit Prices for new items, with supporting information, for inclusion in the Schedule of Unit Price Work.
 - 4. Justification for changes in the Contract Time.
 - 5. Additional data upon request.
- D. For changes in the Work performed on a time-and-material basis, provide the following additional information:
 - 1. Quantities and description of Products.
 - 2. Taxes, insurance and Bonds.
 - 3. Overhead and profit.
 - 4. Dates, times and by who work was performed.
 - 5. Time records and certified copies of applicable payrolls.
 - 6. Invoices and receipts for Products, rental equipment, and subcontracts, similarly documented.
- E. For changes in the Work performed on a time-and-materials basis, rental equipment is paid as follows:
 - 1. Actual invoice cost for duration of time required to complete extra work without markup for overhead and profit. When extra work comprises only a portion of a rental invoice where

- equipment would otherwise be on site, compute hourly equipment rate by dividing the actual monthly invoice by one hundred and seventy-six (176). One day (1 D) equals eight hours (8 Hrs) and one week (1 Wk) equals forty hours (40 Hrs).
2. Do not exceed estimated operating costs given in Houston Area Blue Book for items of equipment. Overhead and profit will be allowed on the operating cost.
- F. For changes in the Work performed on a time-and-materials basis using Contractor-owned equipment, use Houston Area Blue Book rates as follows:
1. Contractor-owned equipment will be paid at the Houston Area Blue Book Rental Rate for the duration of time required to complete extra work without markup for overhead and profit. Utilize lowest cost combination of hourly, daily, weekly or monthly rates. Use one hundred fifty percent (150%) of Rental Rate for double shifts, one (1) extra shift per day, and two hundred percent (200%) of Rental Rate for more than two (2) shifts per day. Standby rates shall be fifty percent (50%) of the appropriate Rental Rate shown in Houston Area Blue Book. No other rate adjustments apply.
 2. Do not exceed estimated operating costs given in Houston Area Blue Book. Overhead and profit will be allowed on operating costs. Operating costs will not be allowed for equipment on standby.

1.4 WORK CHANGE DIRECTIVE

- A. The Project Manager may issue a signed Work Change Directive instructing the Contractor to proceed with a change in the Work. The Work Change Directive shall subsequently be incorporated into a Change Order.
- B. Work Change Directives shall describe changes in the Work and designate the method of determining change in the Contract Price or the Contract Time.
- C. Proceed promptly to execute changes in the Work in accordance with the Work Change Directive.

1.5 UNIT PRICE CHANGE ORDER

- A. Where Unit Prices for affected items of the Work are included in the original Unit Price Form, the Change Order will be based on Unit Prices.
- B. Where Unit Prices of the Work are not pre-determined in the original Unit Price Form, the Work Change Directive shall specify the Unit Prices to be used.

1.6 TIME-AND-MATERIAL CHANGE ORDER

- A. Provide itemized account and supporting data after completion of change, within time limits indicated for claims.

- B. The Project Manager shall determine the change allowable in the Contract Price and Contract Time.
- C. Provide full information required for evaluation of changes and substantiate costs for changes in the Work. The Project Manager shall verify all time-and-material items submitted.

1.7 CORREALATION OF CONTRACTOR SUBMITTALS

- A. For Total Stipulated Price Contracts, promptly revise the Schedule of Values and Application for Payment forms to record authorized Change Orders as a separate line item.
- B. For Unit Price Contracts, the next month's estimate of the Work after acceptance of a Change Order shall be revised to include new items not previously included with appropriate Unit Prices.
- C. Promptly revise progress schedules to reflect change in the Contract Time, and to adjust time for other items of work affected by the change and resubmit for review.
- D. Promptly enter changes to on-site and record copies of the Drawings, the Technical Specifications or the Contract Documents.

1.8 ACCEPTANCE OF CHANGE ORDER

- A. Change Orders, once executed by the Contractor and the City, shall be the only acceptable document that shall be allowed to change the Contract Price or the Contract Time.
- B. No work shall be performed that changes the Contract Price without an approved and signed Work Change Directive or Change Order. Any and all work that proceeds without authorization shall be at the Contractors expense and risk.
- C. If no change in the Contract Time is submitted at the time request for change in the Contract is submitted, it shall be awarded no time for the change. Time shall not be submitted at the end of the project to recoup lost time due to changes in the Work.
- D. Time-and-material changes shall be finalized in a Change Order after the change in work has been completed. Actually time paid under this Change Order shall be added to the Contract to change the Contract Time.

END OF SECTION

WORK RESTRICTIONS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. General use of the site including properties inside and outside the rights-of-way, work affecting road, ramps, streets and driveways and notification to adjacent occupants.

1.2 RIGHTS-OF-WAY

- A. Confine access, operations and storage areas to rights-of-way provided by the City; trespassing on abutting lands or other lands in area shall not be allowed.
- B. Make arrangements, at no cost to the City, for temporary use of private properties. The Contractor and the Surety shall indemnify and hold harmless the City against claims or demands rising from such use of properties outside of rights-of-way.
- C. No material shall be stored in esplanades or medians without prior written approval by the Project Manager.
- D. Restrict total length of distributed materials along the route of construction to one thousand linear feet (1000 Lf) unless otherwise approved by the Project Manager in writing.

1.3 PROPERTIES OUTSIDE THE RIGHTS-OF-WAY

- A. Do not alter the condition of properties adjacent to and along rights-of-way.
- B. Do not use ways, means, methods, techniques, sequences, or procedures that result in damage to properties or improvements.
- C. Restore damaged properties outside of rights-of-way at no cost to the City to as good as or better than the original condition prior to construction.

1.4 USE OF SITE

- A. Obtain approvals from governing authorities prior to impending or closing public roads and streets. Do not close more than two (2) consecutive intersections at one (1) time.
- B. Notify the Project Manager a minimum of five working days (5 wD) prior to closing a street or street crossing. Obtain any required permits for street closures in advance.
- C. Maintain ten foot (10 Ft) wide minimum access for emergency vehicles including access to Fire Hydrants.
- D. Avoid obstructing drainage ditches or inlets. When obstruction is unavoidable due to requirements of the Work, provide grading and temporary drainage structures to maintain unimpeded flow.
- E. Locate, document, and protect private and public lawn sprinkler

systems that may exist within the site. Repair or replace all damaged systems to original or better conditions at the start of the Work.

- F. Conform to daily clean-up requirements.
- G. Beware of overhead power lines existing in the area and in proximity of the Work. When ten feet (10 Ft) of clearance between energized power line and construction-related activity cannot be maintained, request that the power company responsible for the power line de-energize or move the conflicting overhead power line. Schedule, coordinate and pay costs associated with de-energizing or moving the conflicting overhead power lines. When there is no separate pay item for this work, include these costs in various items of bid that make such work necessary.

1.5 NOTIFICATION OF ADJACENT OCCUPANTS

- A. Notify individual occupants in the areas to be affected by the Work of construction and time schedule. Notify not less than seventy-two hours (72 Hrs) no more than two weeks (2 Wks) prior to work being performed within two hundred feet (200 Ft) of homes and/or businesses.
- B. Include in notification nature of the Work, and names and telephone numbers of two (2) company representatives for resident contact that shall be available on twenty-four-hour (24 Hr) call.
- C. Submit proposed notification to the Project Manager for approval at least of twenty-four hours (24 Hrs) in advance of schedule timed to notify adjacent occupants.

1.6 PUBLIC, TEMPORARY AND CONSTRUCTION ROADS AND RAMPS

- A. Construct and maintain temporary detours, ramps and roads to provide for normal public traffic flow when it is necessary to close public roads or streets.
- B. Provide mats or other means to prevent overloading or damage to existing roadways from tracked equipment, large tandem axle trucks and/or equipment that will damage existing roadway surfaces.
- C. Construct and maintain access roads and parking areas.

1.7 EXCAVATION IN STREETS AND DRIVEWAYS

- A. Avoid hindering or inconveniencing public travel on streets and roadways for more than two hours (2 Hrs) at one (1) time, except with prior written approval by the Project Manager.
- B. Obtain the approval of the Director of Engineering and the Director of Public Works when the nature of the Work requires closure of an entire street. Permits required for street closure are the Contractor's responsibility. Avoid unnecessary inconvenience to adjacent property owners.
- C. Remove surplus materials and debris and open each block for public use as work in that block is complete.
- D. Acceptance of any portion of the Work shall not be based solely on the return of the street to public use.

- E. Do not obstruct the ingress/egress of driveways or entrances to private properties without prior written approval by the Project Manager.
- F. Provide temporary crossings or complete excavation and backfill in one (1) continuous operation to minimize the duration of obstruction when excavation is required to cross driveways and entrances.
- G. Provide barricades and signs in accordance with Section VI of the State of Texas Manual on Uniform Traffic Control Devices – latest edition.

1.8 SURFACE RESTORATION

- A. Restore the site to as good as or better than the condition existing before construction commenced.
- C. Repair damaged turf, level with bank sand or topsoil. Water and level newly sodded areas with adjoining turf using appropriate steel wheel rollers for sodding. Do not use spot sodding, checkerboard sodding or sprigging unless otherwise specified or directed by the Project Manager.

1.9 LIMITS OF CONSTRUCTION

- A. Confine operations to lands within construction work limits shown on the Drawings. Unless otherwise noted on the Drawings adhere to the following:
 - 1. Where utility alignment is within esplanade or median, and construction limits are shown on the Drawings to extend to the edge of the esplanade or median, keep equipment, materials and stockpiles a minimum of five feet (5 Ft) from back of curb.
 - 2. Where construction limits shown on the Drawings extend to the property line, keep sidewalks free of equipment, materials, and stockpiles.

1.10 EQUIPMENT AND MATERIAL SALVAGE

- A. Upon completion of the Work, carefully remove salvageable equipment and material. Deliver them to the City of Friendswood as directed by the Project Manager. Dispose of all other equipment not designated to be salvaged offsite at no additional cost to the City.

1.11 WORKING TIME

- A. Normal work hours shall be from seven (7) A.M. to eight (8) P.M Monday through Friday, Central Standard Time.
- B. No work shall be done at any other time than those stated above without prior written approval by the Project Manager.
- C. No work that is in need of inspection shall be undertaken beyond the time listed in paragraph 1.11.A in this Section.
- D. The Contractor can request that unusual circumstances require work, which must be inspected, that must be accomplished outside of the

normal hours listed in paragraph 1.11.A in this Section. In such circumstances the request shall be a minimum of forty-eight hours (48 Hrs.) before the day requested and the following shall apply:

1. The Contractor shall request in writing approval to work beyond the normal work hours. In this request, the Contractor shall state the reason for each request. Permission is at the sole discretion of the Director of Engineering.
 2. The Contractor shall pay to the City for the Project Manager or other City Personnel in accordance with the City's Adopted Fee Schedule.
 3. The Contractor shall also pay for the Independent Testing Laboratory if needed.
- E. Request to work on days other than normal working days does not constitute an approval to do so. Work on Saturday, Sunday and/or Holidays shall only be done after such request has been approved by the Director of Engineering.

END OF SECTION

STABILIZED CONSTRUCTION EXIT

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Installation of erosion and sediment control for stabilized construction exits used during construction and prior to final development of site.

1.2 SUBMITTALS

- A. Submit manufacturers catalog sheets and other Product Data on geotextile fabric.
- B. Submit sieve analysis of aggregates conforming to requirements of this Technical Specification.

1.3 REFERENCES

- A. ASTM – American Society for Testing and Materials.
 - 1. ASTM D 4632 -Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
- C. Storm Water Management Plan Manual prepared by the City of Friendswood.

PART II: PRODUCTS

2.1 GEOTEXTILE FABRIC

- A. Provide woven or non-woven geotextile fabric made of polypropylene, polyethylene, ethylene, or polyamide material.
- B. Geotextile fabric: Minimum grab strength of two hundred seventy pounds per square inch (270 psi) in any principal direction (ASTM D-4632) and equivalent opening size between fifty millimeters (50 mm) and one hundred forty millimeters (140 mm).
- C. Geotextile and threads: Resistant to chemical attack, mildew, and rot and contain ultraviolet ray inhibitors and stabilizers to provide minimum of six months (6 Mos) of expected usable life at temperature range of zero degrees Fahrenheit (0° F) to one hundred twenty degrees Fahrenheit (120° F).
- D. Representative Manufacturers: Mirafi, Inc. or equal.

2.2 COARSE AGGREGATES

- A. Coarse aggregate: Crushed stone, gravel, crushed blast furnace slag, or combination of these materials. Aggregate shall be composed of clean, hard, durable materials free from adherent coatings of, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic and injurious matter.
- B. Coarse aggregates shall conform to gradation requirements in TABLE 4.1 – GRADATION REQUIREMENTS FOR COARSE AGGREGATES in this Section.

PART III: EXECUTION

3.1 PREPARATION AND INSTALLATION

- A. Provide stabilized construction roads and exits at construction staging, parking, storage and disposal areas to keep streets clean of mud carried by construction vehicles and equipment. Construct erosion and sediment controls in accordance with the Drawings and Technical Specification requirements.
- B. Do not clear grub or rough cut until erosion and sediment control systems are in place, unless approved by the Project Manager to allow soil testing and surveying.
- C. Maintain existing construction site erosion and sediment control systems until acceptance of the Work or until removal of existing systems is approved by the Project Manager.
- D. Regularly inspect, repair or replace components of stabilized construction exits. Unless otherwise directed, maintain stabilized construction roads and exits until the City accepts the Work. Remove stabilized construction roads and exits promptly when directed by the Project Manager. Discard removed materials off-site.
- E. Remove and dispose of sediment deposits at designated spoil site for the Project. If a spoil site is not designated on the Drawings, dispose of sediment off-site at a location not in or adjacent to stream or flood plain. Assume responsibility for off-site disposal.
- F. Spread compacted and stabilized sediment evenly throughout site. Do not allow sediment to flush into streams or drainage ways. Dispose of contaminated sediment in accordance with existing federal, state, and local rules and regulations.
- G. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage to erosion and sediment control systems caused by construction traffic.
- H. Conduct construction operations in conformance with erosion control requirements of Section 01045 – Storm Water Pollution Prevention Plan Controls.

3.2 CONSTRUCTION METHODS

- A. Provide stabilized access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes where shown on the Drawings.
- B. Provide stabilized construction exits and truck washing areas, when approved by the Project Manager, of sizes and at locations shown on the Drawings or as specified in this Section.
- C. Clean tires to remove sediment on vehicles leaving construction areas prior to entering public right-of-ways. Construct truck washing areas needed to remove sediment. Wash trucks on stabilized areas that drain into drainage systems protected by erosion and sediment control measures.
- D. Details for stabilized construction exits are shown on the Drawings.

Construct other stabilized areas to same requirements. Maintain minimum roadway widths of fourteen feet (14 Ft) for one-way traffic and twenty feet (20 Ft) for two-way traffic and of sufficient width to allow ingress and egress. Place geotextile fabric as a permeable separator to mixing of coarse aggregate with underlying soil. Limit exposure of geotextile fabric to elements between laydown and cover to a maximum fourteen days (14 D) to minimize potential damage.

- E. Grade roads and parking areas to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar materials to prevent sediment from entering public right-of-ways, receiving streams or storm water conveyance systems.
- F. Inspect and maintain stabilized areas daily. Provide periodic top dressing with additional coarse aggregates to maintain required depth. Repair and clean out damaged control systems used to trap sediment. Immediately remove spilled, dropped, washed, or tracked sediment from public right-of- ways.
- G. Maintain lengths of stabilized areas as shown on the Drawings or a minimum of fifty feet (50 Ft). Maintain a minimum thickness of eight inches (8 In). Maintain minimum widths at all points of ingress or egress.
- H. Stabilize other areas with the same thickness, and width of coarse aggregate required for stabilized construction exits, except where shown otherwise on the Drawings.
- I. Stabilized areas may be widened or lengthened to accommodate truck washing areas when authorized by the Project Manager.
- J. Clean streets daily before end of workday. When excess sediments have tracked onto streets, the Project Manager may direct the Contractor to clean street as often as necessary. Remove and legally dispose of sediments.
- K. Use other erosion and sediment control measures to prevent sediment runoff during rain periods and non-working hours and when storm discharges are expected.

PART IV: TABLES

4.1 GRADATION REQUIREMENTS FOR COARSE AGGREGATES

SIEVE SIZE (Square Mesh)	PERCENT RETAINED (By Weight)
2-1/2"	0%
2"	0% - 20%
1-1/2"	15% - 50%
3/4"	60% - 80%
No. 4	95% - 100%

END OF SECTION

CONTROL OF GROUND AND SURFACE WATER

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Dewatering, depressurizing, draining, and maintaining trenches, shaft excavations, structural excavations and foundation beds in stable condition, and controlling ground water conditions for tunnel excavations.
- B. Protecting work against surface runoff and rising floodwaters.
- C. Trapping suspended sediment in the discharge from the surface and ground water control systems.

1.3 REFERENCES

- A. ASTM – American Society for Testing and Materials.
 - 1. ASTM D698 – Standard Test Methods for Laboratory Compaction of Soils Using Standard Effort (12,400 ft-lbf/ft³ (600kN-m/m³).
- B. CFSWMP – City of Friendswood Storm Water Management Plan manual.
- C. Federal Regulations.
 - 1. Federal Regulation 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).
- D. TCEQ – Texas Commission on Environmental Quality.
- E. TWWDA – Texas Water Well Drillers Association.

1.4 DEFINITIONS

- A. Ground water control system: system used to dewater and depressurize water-bearing soil layers.
 - 1. Dewatering: Lowering the water table and intercepting seepage that would otherwise emerge from slopes or bottoms of excavations, or into tunnels and shafts; and disposing of removed water. Intent of dewatering is to increase stability of tunnel excavations and excavated slopes, prevent dislocation of material from slopes or bottoms of excavations, reduce lateral loads on sheeting and bracing, improve excavating and hauling characteristics of excavated material, prevent failure or heaving of bottom of excavations, and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.
 - 2. Depressurization: Includes reduction in piezometric pressure within strata not controlled by dewatering alone, necessary to prevent failure or heaving of excavation bottom or instability of tunnel excavations.
- B. Excavation drainage: Includes keeping excavations free of surface and seepage water.
- C. Surface drainage: Includes use of temporary drainage ditches and dikes

and installation of temporary culverts and sump pumps with discharge lines necessary to protect Work from any source of surface water.

- D. Monitoring facilities for ground water control system: Includes piezometers, monitoring wells and flow meters for observing and recording flow rates.

1.5 PERFORMANCE REQUIREMENTS

- A. Conduct subsurface investigations to identify groundwater conditions and to provide parameters for design, installation, and operation of groundwater control systems. Submit proposed method and spacing of readings for review prior to obtaining water level readings.
- B. Design ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 to produce following results:
 - 1. Effectively reduce hydrostatic pressure affecting:
 - a. Excavations.
 - b. Tunnel excavation, face stability or seepage into tunnels.
 - 2. Develop substantially dry and stable subgrade for subsequent construction operations.
 - 3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities and other work.
 - 4. Prevent loss of fines, seepage, boils, quick condition, or softening of foundation strata.
 - 5. Maintain stability of sides and bottom of excavations.
- C. Provide ground water control systems that include single-stage or multiple-stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types.
- D. Provide drainage of seepage water and surface water, as well as water from other sources entering excavation. Excavation drainage may include placement of drainage materials, crushed stone and filter fabric, together with sump pumping.
- E. Provide ditches, berms, pumps and other methods necessary to divert and drain surface water from excavation and other work areas.
- F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.
- G. Assume sole responsibility for ground water control systems and for any loss or damage resulting from partial or complete failure of protective measures and settlement or resultant damage caused by ground water control operations. Modify ground water control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, adjacent water wells, or potentially contaminated areas. Repair damage caused by ground water control systems or resulting from failure of system to protect property as required.
- H. Install an adequate number of piezometers installed at proper locations and depths, necessary to provide meaningful observations of conditions

affecting excavation, adjacent structures and water wells.

- I. Install environmental monitoring wells at proper locations and depths necessary to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into work area or ground water control system.

1.6 SUBMITTALS

- A. Submit Ground Water and Surface Water Control Plan for review by the Project Manager prior to start of excavation work. Include the following:
 1. Results of subsurface investigations and description of extent and characteristics of water bearing layers subject to ground water control.
 2. Names of equipment Suppliers and installation Subcontractors.
 3. Description of proposed ground water control systems indicating arrangement, location, depth and capacities of system components, installation details and criteria and operation and maintenance procedures.
 4. Description of proposed monitoring facilities indicating depths and locations of piezometers and monitoring wells, monitoring installation details and criteria, type of equipment and instrumentation with pertinent data and characteristics.
 5. Description of proposed filters including types, sizes, capacities and manufacturer's application recommendations.
 6. Design calculations demonstrating adequacy of proposed systems for intended applications. Define potential area of influence of ground water control operation near contaminated areas.
 7. Operating requirements, including piezometric control elevations for dewatering and depressurization.
 8. Excavation drainage methods including typical drainage layers, sump pump application and other means.
 9. Surface water control and drainage installations.
 10. Proposed methods and locations for disposing of removed water.
- B. Submit following records upon completion of initial installation:
 1. Installation and development reports for well points, eductors, and deep wells.
 2. Installation reports and baseline readings for piezometers and monitoring wells.
 3. Baseline analytical test data of water from monitoring wells.
 4. Initial flow rates.
- C. Submit the following records weekly during control of ground and surface water operations:
 1. Records of flow rates and piezometric elevations obtained during monitoring of dewatering and depressurization. Refer to Paragraph 3.2, Requirements for Eductor, Well Points, or Deep Wells.

2. Maintenance records for ground water control installations, piezometers and monitoring wells.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Comply with requirements of agencies having jurisdiction.
- B. Comply with Texas Commission on Environmental Quality (TCEQ) regulations and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.
- C. Obtain necessary permits from agencies with jurisdiction over use of groundwater and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Since review and permitting process may be lengthy, take early action to obtain required approvals.
- D. Monitor ground water discharge for contamination while performing pumping in vicinity of potentially contaminated sites.

PART II: PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. Select equipment and materials necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review by the Project Manager.
- B. Use experienced contractors, regularly engaged in ground water control system design, installation, and operation, to furnish and install and operate eductors, well points, or deep wells, when needed.
- C. Maintain equipment in good repair and operating condition.
- D. Keep sufficient standby equipment and materials available to ensure continuous operation, where required.
- E. Portable Sediment Tank System: Standard fifty-five gallon (55 Gal) steel or plastic drums, free of hazardous material contamination.
 1. Shop or field fabricate tanks in series with main inlet pipe, inter-tank pipes and discharge pipes, using quantities sufficient to collect sediments from discharge water.

PART III: EXECUTION

3.1 GROUND WATER CONTROL

- A. Perform necessary subsurface investigation to identify water bearing layers, piezometric pressures and soil parameters for design and installation of ground water control systems. Perform pump tests, if necessary to determine draw down characteristics. Present results in the Ground Water and Surface Water Control Plan submittal.
- B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in manner compatible with construction methods and site conditions. Monitor effectiveness of installed system and its effect on adjacent property.

- C. Install, operate, and maintain ground water control systems in accordance with the Ground Water and Surface Water Control Plan. Notify the Project Manager in writing of changes made to accommodate field conditions and changes to Work. Provide revised drawings and calculations with notification.
- D. Provide continuous system operation, including nights, weekends, and holidays. Arrange appropriate backup if electrical power is primary energy source for dewatering system.
- E. Monitor operations to verify systems lower ground water piezometric levels at rate required to maintain dry excavation resulting in stable subgrade for subsequent construction operations.
- F. Depressurize zones where hydrostatic pressures in confined water bearing layers exist below excavations to eliminate risk of uplift or other instability of excavation or installed works. Define allowable piezometric elevations in the Ground Water and Surface Water Control Plan.
- G. Removal of ground water control installations.
 - 1. Remove pumping system components and piping when ground water control is no longer required.
 - 2. Remove piezometers, including piezometers installed during design phase investigations and left for the Contractor's use, upon completion of testing, as required in accordance with Part III of applicable specification.
 - 3. Remove monitoring wells when directed by the Project Manager.
 - 4. Grout abandoned well and piezometer holes. Fill piping that is not removed with cement-bentonite grout or cement-sand grout.
- H. During backfilling, maintain water level a minimum of five feet (5 Ft) below prevailing level of backfill. Do not allow the water level to cause uplift pressures in excess of eighty percent (80%) of downward pressure produced by weight of structure or backfill in place. Do not allow water levels to rise into cement-stabilized sand until at least forty-eight hours (48 Hrs) after placement.
- I. Provide uniform pipe diameter for each pipe drain run constructed for dewatering. Remove pipe drains when no longer required. If pipe removal is impractical, grout connections at fifty foot (50 Ft) intervals and fill pipe with cement-bentonite grout or cement-sand grout after removal from service.
- J. The extent of ground water control for structures with permanent perforated underground drainage systems may be reduced, for units designed to withstand hydrostatic uplift pressure. Provide a means to drain affected portions of underground systems, including standby equipment. Maintain drainage systems during construction operations.
- K. Remove systems upon completion of construction or when dewatering and control of surface or ground water is no longer required.
- L. Compact backfill to not less than ninety-five percent (95%) of maximum dry density in accordance with ASTM D698.
- M. Foundation Slab: Maintain saturation line at least three feet (3 Ft) below lowest elevations where concrete is to be placed. Drain foundations in

areas where concrete is to be placed before placing reinforcing steel. Keep free from water for three days (3 D) after concrete is placed.

3.2 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS

- A. For aboveground piping in ground water control system, include a twelve inch (12 In) minimum length of clear, transparent piping between each eductor well or well point and discharge header to allow visual monitoring of discharge from each installation.
- B. Install sufficient piezometers or monitoring wells to show that trench or shaft excavations in water bearing materials are pre-drained prior to excavation. Provide separate piezometers for monitoring of dewatering and for monitoring of depressurization. Install piezometers and monitoring wells for tunneling as appropriate for selected method of work.
- C. Install piezometers or monitoring wells at least one week (1 Wk) in advance of the start of associated excavation.
- D. Dewatering may be omitted for portions of under drains or other excavations, where auger borings and piezometers or monitoring wells show that soil is pre-drained by existing systems and that ground water control plan criteria are satisfied.
- E. Replace installations that produce noticeable amounts of sediments after development.
- F. Provide additional ground water control installations, or change method of control if, ground water control plan does not provide satisfactory results based on performance criteria defined by plan and by specifications. Submit revised plan according to Paragraph 1.6.B.

3.3 SEDIMENT TRAPS

- A. Install sediment tank as shown on approved plan.
- B. Inspect daily and clean out tank when one-third (1/3) of sediment tank is filled with sediment.

3.4 SEDIMENT SUMP PIT

- A. Install sediment sump pits as shown on approved plan.
- B. Construct standpipe by perforating twelve inch (12 In) to twenty-four inch (24 In) diameter corrugated metal or PVC pipe.
- C. Extend standpipe twelve inches (12 In) to eighteen inches (18 In) above lip of pit.
- D. Convey discharge of water pumped from standpipe to sediment trapping device.
- E. Fill sites of sump pits, compact to density of surrounding soil and stabilize surface when construction is complete.

3.5 EXCAVATION DRAINAGE

- A. Use excavation drainage methods if well-drained conditions can be achieved. Excavation drainage may consist of layers of crushed stone and filter fabric, and sump pumping, in combination with sufficient ground water control wells to maintain stable excavation and backfill conditions.

3.6 MAINTENANCE AND OBSERVATION

- A. Conduct daily maintenance and observation of piezometers or monitoring wells while ground water control installations or excavation drainage is operating at the site, or water is seeping into tunnels, and maintain systems in good operating condition.
- B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedules.
- C. Cut off piezometers or monitoring wells in excavation areas where piping is exposed, only as necessary to perform observation as excavation proceeds. Continue to maintain and make specified observations.
- D. Remove and grout piezometers inside or outside of excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by the Project Manager.

3.7 MONITORING AND RECORDING

- A. Monitor and record average flow rate of operation for each deep well, or for each wellpoint or eductor header used in dewatering system. Also, monitor and record water level and ground water recovery. Record observations daily until steady conditions are achieved and twice weekly thereafter.
- B. Observe and record elevation of water level daily as long as ground water control system is in operation, and weekly thereafter until Work is completed or piezometers or wells are removed, except when the Project Manager determines more frequent monitoring and recording are required. Comply with the Project Manager's direction for increased monitoring and recording and take measures necessary to ensure effective dewatering for intended purpose.

3.8 SURFACE WATER CONTROL

- A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other approved means. Requirement includes temporary works required to protect adjoining properties from surface drainage caused by construction operations.
- B. Divert surface water and seepage water into sumps and pump it into drainage channels or storm drains, when approved by agencies having jurisdiction. Provide settling basins when required by agencies.

END OF SECTION

STORM WATER POLLUTION CONTROL

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Implementation of Storm Water Pollution Prevention Plans (SW3P) described in Section 01055 -TPDES Requirement.
- B. Installation and maintenance of storm-water pollution prevention structures: diversion dikes, interceptor dikes, diversion swales, interceptor swales, down spout extenders, pipe slope drains, paved flumes and level spreaders. Structures are used during construction and prior to final development of the site.
- C. Filter Fabric Fences:
 - 1. Type 1: Temporary filter fabric fences for erosion and sediment control in non-channelized flow areas.
 - 2. Type 2: Temporary reinforced filter fabric fences for erosion and sediment control in channelized flow areas.
- D. Straw Bale Fence.

1.2 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials.
 - 1. A36 – Standard Specification for Carbon Structural Steel.
 - 2. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 3. D3786 – Standard Test Method for Hydraulic Bursting Strength for Knitted Goods and Nonwoven Fabrics.
 - 4. D4355 – Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
 - 5. D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - 6. D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - 7. D4833 – Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
 - 8. D6382 – Standard Practice for Dynamic Mechanical Analysis and Thermogravimetry of Roofing and Waterproofing Membrane Material.
- B. City of Friendswood Storm Water Management Plan manual.

1.3 SYSTEM DESCRIPTIONS

- A. Filter Fabric Fence Type 1 and Type 2: Install to allow surface or channel runoff percolation through fabric in sheet-flow manner and to retain and accumulate sediment. Maintain Filter Fabric Fences to remain in proper position and configuration at all times.
- B. Straw Bale Fence: Install to allow surface runoff percolation through straw in sheet-flow manner and to retain and accumulate sediment. Maintain Straw Bale Fence to remain in proper position and configuration at all times.
- C. Interceptor Dikes and Swales: Construct to direct surface or channel runoff around the project area or runoff from the project area into sediment traps.
- D. Drop Inlet Baskets: Install to allow runoff percolation through the basket and to retain and accumulate sediment. Clean accumulation of sediment to prevent clogging and backups.
- E. Sediment traps: Construct to pool surface runoff from construction area to allow sediment to settle onto the bottom of trap.

1.4 SUBMITTALS

- A. Submit manufacturer's literature for product specifications and installation instructions.
- B. Submit manufacturers catalog sheets and other product data on geotextile or filter fabrics, outlet pipe, perforated riser and connectors.
- C. Submit proposed methods, equipment, materials, and sequence of operations for storm-water pollution prevention structures.
- D. Submit shop drawings for Drop Inlet Baskets.

PART II: PRODUCTS

2.1 AGREGATE MATERIALS

- A. Use poorly graded cobbles with diameter greater than three inches (3 In) and less than five inches (5 In).
- B. Provide clean cobbles and gravel consisting of crushed concrete or stone. Use clean, hard crushed concrete or stone free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic matter.
- C. Sediment Pump Pit Aggregate: Use nominal two inch (2 In) diameter river gravel.

2.2 PIPE

- A. Polyethylene culvert pipe or PVC sewer pipe in accordance with Section 02220 – High Density Polyethylene (HDPE) Solid and Profile Wall Pipe and Section 02235 – Polyvinyl Chloride Pipe (PVC) or as shown on the Drawings.
- B. Inlet Pipes: Galvanized steel pipe in accordance with Section 02210 – Corrugated Metal Pipe (CMP) or as shown on the Drawings.
- C. Standpipe for Sediment Pump Pits: Galvanized round culvert pipe or

round PVC pipe, a minimum of twelve inch (12 In) and a maximum of twenty-four inch (24 In) diameter, perforate at six inch (6 In) to twelve inch (12 In) centers around circumference.

2.3 GEOTEXTILE FILTER FABRIC

- A. Woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material, in continuous rolls of longest practical length.
- B. Grab Strength: one hundred pounds per square inch (100 psi) in any principal direction (ASTM D4632), Mullen burst strength > two hundred pounds per square inch (200 psi) (ASTM D3786), and equivalent opening size between fifty millimeters (50 mm) and one hundred forty millimeters (140 mm).
- C. Furnish ultraviolet inhibitors and stabilizers for a minimum six months (6 Mos) of expected usable construction life at temperature range of zero degrees Fahrenheit (0° F) to one hundred twenty degrees Fahrenheit (120° F).
- D. Mirafi, Inc., Synthetic Industries, or equivalent.

2.4 FENCING

- A. Wire Fencing: Woven galvanized steel wire, fourteen (14) gauge by six inch (6 In) square mesh spacing, a minimum twenty-four inch (24 In) roll or sheet width of longest practical length.
- B. Fence Stakes: Nominal two inch by two inch (2 In x 2 In) moisture-resistant treated wood or steel posts [min. of one and one-quarter pounds per linear foot (1.25 Lbs/Lf) and Brinell Hardness greater than one hundred forty (140)] with safety caps on top; length as required for a minimum eight inch (8 In) bury and full height of filter fabric.

2.5 DROP INLET BASKET

- A. Provide steel frame members in accordance with ASTM A36.
- B. Construct top frame of basket with two (2) short sides of two inch by two inch (2 In x 2 In) and single long side of one inch by one inch (1 In x 1 In), one-eighth inch (1/8 In) angle iron. Construct basket hangers of two inch by one-quarter inch (2 In x 1/4 In) iron bars. Construct bottom frame of one inch by one-quarter inch (1 In x 1/4 In) iron bar or one-quarter inch (1/4 In) plate with center three inches (3 In) removed. Use a minimum one-quarter inch (1/4 In) diameter iron rods or equivalent for sides of inlet basket. Weld a minimum of fourteen (14) rods in place between top frame/basket hanger and bottom frame. Exact dimensions for top frame and insert basket shall be determined based on dimensions of type of inlet being protected.

2.6 STRAW BALE

- A. Straw: Standard-baled agricultural hay bound by wire, nylon, or polypropylene rope. Do not use jute or cotton binding.
- B. Straw Bale Stakes (applicable where bales are on soil): No. 3 (3/8 inch

diameter) reinforcing bars, deformed or smooth at Contractor's option, length as required for a minimum eighteen inch (18 In) bury and full height bales.

PART III: EXECUTION

3.1 PREPARATION, INSTALLATION AND MAINTAINANCE

- A. Do not clear, grub or rough cut until erosion and sediment control systems are in place unless approved by the Project Manger to allow installation of erosion and sediment control systems, soil testing and surveying.
- B. Maintain existing erosion and sediment control systems located within the project site until acceptance of the Project or until directed by the Project Manger to remove and discard existing system.
- C. Regularly inspect and repair or replace damaged components of erosion and sediment control structures. Unless otherwise directed, maintain erosion and sediment control structure until the project area stabilization is accepted. Redress and replace granular fill at outlets as needed to replenish depleted granular fill. Remove erosion and sediment control structures promptly when directed by the Project Manger.
- D. Remove and dispose sediment deposits at the designated spoil site for the Project.
- E. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated right of way and easements for construction. Immediately repair damage caused by construction traffic to erosion and sediment control structures.

3.2 SEDIMENT TRAPS

- A. Install sediment traps so that surface runoff shall percolate through system in sheet flow fashion and allow retention and accumulation of sediment.
- B. Inspect sediment traps after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately.
- C. Use fill material for embankment.
- D. Excavation length and height shall be as specified on the Drawings. Use side slopes of two to one (2:1) or flatter.
- E. Stone outlet sediment traps:
 - 1. Maintain a minimum of six inches (6 In) between top of core material and top of stone outlet, a minimum of four inches (4 In) between bottom of core material and existing ground and a minimum of one foot (1 Ft) between top of stone outlet and top of embankment.
 - 2. Embed cobbles a minimum of four inches (4 In) into existing ground for stone outlet. Core shall be a minimum of one foot (1 Ft) in height and in width and wrapped in triple layer of geotextile filter fabric.

- F. Sediment Basin with Pipe Outlet Construction Methods: Install outlet pipe and riser as shown on the Drawings.
- G. Remove sediment deposits when design basin volume is reduced by one-third (1/3) or sediment level is one foot (1 Ft) below principal spillway crest, whichever is less.

3.3 FILTER FABRIC FENCE CONSTRUCTION METHODS.

A. Fence Type 1:

- 1. Install stakes three feet (3 Ft) on center maximum and firmly embed a minimum eight inches (8 In) in soil. If filter fabric is factory preassembled with support netting, then maximum support spacing is eight feet (8 Ft). Install wood stakes at a slight angle toward the source of anticipated runoff.
- 2. Trench in the toe of the fence lines so the downward face of the trenches is flat and perpendicular to direction of flow. V-trench configuration as shown on the Drawings may also be used.
- 3. Lay fabric along edges of trenches in longest practical continuous runs to minimize joints. Make joints only at a support post. Splice with a minimum six inch (6 In) overlap and seal securely.
- 4. Staple filter fabric to stakes at maximum three inches (3 In) on center. Extend fabric a minimum eighteen inches (18 In) and a maximum thirty-six inches (36 In) above natural ground.
- 5. Backfill and compact trench.

B. Fence Type 2:

- 1. Layout fence same as for Type 1.
- 2. Install stakes at six feet (6 Ft) on center maximum and at each joint in wire fence, firmly embedded one foot (1 Ft) minimum, and inclined it as for Type 1.
- 3. Tie wire fence to stakes with wire at six inches (6 In) on center maximum. Overlap joints a minimum one (1) bay of mesh.
- 4. install trench same as for Type 1.
- 5. Fasten filter fabric wire fence with tie wires at three inches (3 In) on center maximum.
- 6. Layout fabric same as for Type 1. Fasten to wire fence with wire ties at three inches (3 In) on center maximum and, if applicable, to stakes above top of wire fence it as for Type 1.
- 7. Backfill and compact trench.

C. Attach filter fabric to wooden fence stakes spaced a maximum of six feet (6 Ft) apart or steel fence stakes spaced a maximum of eight feet (8 Ft) apart and embedded a minimum of twelve inches (12 In). Install stakes at a slight angle toward source of anticipated runoff.

- D. Trench in toe of filter fabric fence with spade or mechanical trencher so that downward face of trench is flat and perpendicular to direction of flow. A V-trench configuration may also be used. Lay filter fabric along edges of trench. Backfill and compact trench upon completion of Construction.
- E. Filter fabric fence shall have a minimum height of eighteen inches (18 In)

- and a maximum height of thirty-six inches (36 In) above natural ground.
- F. Cut length of fence to minimize use of joints. When joints are necessary, splice fabric together only at support post with a minimum six inch (6 In) overlap and seal securely.
 - G. Triangular Filter Fabric Fence Construction Methods:
 - 1. Attach filter fabric to wire fencing, eighteen inches (18 In) on each side. Provide a fabric cover and skirt with continuous wrapping of fabric. Skirt should form continuous extension of fabric on upstream side of fence.
 - 2. Secure triangular fabric filter fence in place using one (1) of the following methods:
 - a. Toe-in skirt six inches (6 In) with mechanically compacted material;
 - b. Weight down skirt with continuous layer of three inch (3 In) to five inch (5 In) graded rock; or
 - c. Trench-in entire structure four inches (4 In).
 - 3. Anchor triangular fabric filter fence structure and skirt securely in place using six inch (6 In) wire staples on two foot (2 Ft) centers on both edges and on skirt, or staked using eighteen inch (18 In) by three-eighths inch (3/8 In) diameter re-bar with tee ends.
 - 4. Lap fabric filter material by six inches (6 In) to cover segment joints. Fasten joints with galvanized shoat rings.
 - H. Reinforced Filter Fabric Barrier Construction Methods
 - 1. Attach woven wire fence to fence stakes.
 - 2. Securely fasten filter fabric material to wire fence with tie wires.
 - 3. When used in swales, ditches or diversions, elevation of barrier at top of filter fabric at flow line location in channel shall be lower than bottom elevation of filter fabric at ends of barrier or top of bank, whichever is less, in order to keep storm water discharge in channel from overtopping bank.
 - 4. Remove sediment deposits when silt reaches depth one-third (1/3) height of barrier or six inches (6 In), whichever is less.

3.4 DIKE AND SWALE

- A. Unless otherwise indicated, maintain a minimum dike height of eighteen inches (18 In), measured from cleared ground at up slope toe to top of dike. Maintain side slopes of two to one (2:1) or flatter.
- B. Dike and Swale Stabilization: When shown on the Drawings, place gravel lining three inches (3 In) thick and compacted into the soil or six inches (6 In) thick if truck crossing is expected. Extend gravel lining across bottom and up both sides of swale a minimum height of eight inches (8 In) vertically, above bottom. Gravel lining on dike side shall extend up the up slope side of dike a minimum height of eight inches (8 In), measured vertically from interface of existing or graded ground and up slope toe of dike, as shown on the Drawings.
- C. Divert flow from dikes and swales to sediment basins, stabilized outlets, or sediment trapping devices of types and at locations shown on the

Drawings. Grade dikes and swales as shown on the Drawings, or, if not specified, provide positive drainage with a maximum grade of one percent (1%) to outlet or basin.

- D. Carry out excavation for swale construction so that erosion and water pollution is minimal. A minimum depth shall be one foot (1 Ft) and bottom width shall be four feet (4 Ft), with level swale bottom. Excavation slopes shall be two to one (2:1) or flatter. Clear, grub and strip excavation area of vegetation and root material.

3.5 DOWN SPOUT EXTENDER

- A. Down spout extender shall have slope of approximately one percent (1%). Use pipe diameter of four inches (4 In) or as shown on the Drawings.

3.6 PIPE SLOPE DRAIN

- A. Compact soil around and under drain entrance section to top of embankment in lifts appropriately sized for method of compaction utilized.
- B. Inlet pipe shall have slope of one percent (1%) or greater. Use pipe diameter as shown on the Drawings.
- C. Top of embankment over inlet pipe and embankments directing water to pipe shall be at least one foot (1 Ft) higher at all points than top of inlet pipe.
- D. Pipe shall be secured with hold-down grommets spaced ten feet (10 Ft) on centers.
- E. Place riprap apron with a depth equal to pipe diameter with two to one (2:1) side slopes.

3.7 PAVED FLUME

- A. Compact soil around and under the entrance section to top of the embankment in lifts appropriately sized for method of compaction utilized.
- B. Construct subgrade to required elevations. Remove and replace soft sections and unsuitable material. Compact subgrade thoroughly and shape to a smooth, uniform surface.
- C. Construct permanent paved flumes in accordance with the Drawings.
- D. Remove sediment from riprap apron when sediment has accumulated to depth of one foot (1 Ft).

3.8 LEVEL SPREADER

- A. Construct level spreader on undisturbed soil and not on fill. Ensure that spreader lip is level for uniform spreading of storm runoff.
- B. Maintain at required depth, grade, and cross section as specified on the Drawings. Remove sediment deposits as well as projections or other irregularities which shall impede normal flow.

3.9 INLET PROTECTION BARRIER

- A. Place sandbags and filter fabric fences at locations shown on the SW3P.

3.10 DROP INLET BASKET CONSTRUCTION METHODS

- A. Fit inlet insert basket into inlet without gaps around insert at locations shown on the SW3P.
- B. Support for inlet insert basket shall consist of fabricated metal as shown on the Drawings.
- C. Push down and form filter fabric to shape of basket. Use sheet of fabric large enough to be supported by basket frame when holding sediment and extend at least six inches (6 In) past frame. Place inlet grates over basket/frame to serve as fabric anchor.
- D. Remove sediment deposit after each storm event and whenever accumulation exceeds one inch (1 In) depth during weekly inspections.

3.11 STRAW BALE FENCE CONSTRUCTION METHODS

- A. Place bales in row with ends tightly abutting adjacent bales. Place bales with bindings parallel to ground surface.
- B. Embed bale in soil a minimum of four inches (4 In).
- C. Securely anchor bales in place with Straw Bale Stakes driven through bales a minimum of eighteen inches (18 In) into ground. Angle first (1st) stake in each bale toward previously laid bale to force bales together.
- D. Fill gaps between bales with straw to prevent water from channeling between bales. Wedge carefully in order not to separate bales.
- E. Replace with new straw bale fence every two months (2 Mos) or as required by the Project Manager.

3.12 BRUSH BERM CONSTRUCTION METHODS

- A. Construct brush berm along contour lines by hand placing method. Do not use machine placement of brush berm.
- B. Use woody brush and branches having diameter less than two inches (2 In) with six inches (6 In) overlap. Avoid incorporation of annual weeds and soil into brush berm.
- C. Use a minimum height of eighteen inches (18 In) measured from top of existing ground at upslope toe to top of berm. Top width shall be twenty-four (24) inches minimum and side slopes shall be two to one (2:1) or flatter.
- D. Embed brush berm into soil a minimum of four inches (4 In) and anchor using wire, nylon or polypropylene rope across berm with a minimum tension of fifty pounds (50 Lbs). Tie rope securely to eighteen inch (18 In) by three-eighths inch (3/8 In) diameter rebar stakes driven into ground on four foot (4 Ft) centers on both sides of berm.

3.13 STREET AND SIDEWALK CLEANING

- A. Keep areas clean of construction debris and mud carried by construction vehicles and equipment. If necessary, install stabilized construction exits at construction, staging, storage, and disposal areas.

- B. In lieu of or in addition to stabilized construction exits, shovel or sweep pavements as required to keep areas clean. Do not waterhose or sweep debris and mud off street into adjacent areas, except, hose sidewalks during off-peak hours, after sweeping.

3.14 WASTE COLLECTION AREAS

- A. Prevent water runoff from passing through waste collection areas, and prevent water runoff from waste collection areas migrating outside collection areas.

3.15 EQUIPMENT MAINTENANCE AND REPAIR

- A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose, so fuels, lubricants, solvents, and other potential pollutants are not washed directly into receiving streams or storm water conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid and solid waste. Clean and inspect maintenance areas daily.
- B. Where designated equipment maintenance areas are not feasible, take precautions during each individual repair or maintenance operation to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

3.16 VEHICLE/EQUIPMENT WASHING AREAS

- A. Install wash area (stabilized with coarse aggregate) adjacent to stabilized construction exit(s), as required to prevent mud and dirt run-off. Release wash water into drainage swales or inlets protected by erosion and sediment controls. Build wash areas and install gravel or rock base beneath wash areas.
- B. Wash vehicles only at designated wash areas. Do not wash vehicles such as concrete delivery trucks or dump trucks and other construction equipment at locations where runoff flows directly into watercourses or storm water conveyance systems.
- C. Locate wash areas to spread out and evaporate or infiltrate wash water directly into ground, or collect runoff in temporary holding or seepage basins.

3.17 WATER RUNOFF AND EROSION CONTROL

- A. Control surface water, runoff, subsurface water, and water from excavations and structures to prevent damage to the Work, the site, or adjoining properties.
- B. Control fill, grading and ditching to direct water away from excavations, pits, tunnels, and other construction areas, and to direct drainage to proper runoff courses to prevent erosion, sedimentation or damage.
- C. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.
- D. Dispose of drainage water to prevent flooding, erosion, or other damage to the site or adjoining areas. Follow environmental requirements.

- E. Retain existing drainage patterns external to the site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover as required to control conditions.
- F. Plan and execute construction and earth work to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
 - 1. Hold area of bare soil exposed at one (1) time to a minimum.
 - 2. Provide temporary controls such as berms, dikes, and drains.
- G. Construct fill and waste areas by selective placement to eliminate surface silts or clays which shall erode.
- H. Inspect earthwork periodically to detect start of erosion. Immediately apply corrective measures as required to control erosion.
- I. Dispose of sediments offsite, not in or adjacent to streams or floodplains, nor allow sediments to flush into streams or drainage ways. Assume responsibility for offsite disposal location.
- J. Unless otherwise indicated, compact embankments, excavations, and trenches by mechanically blading, tamping, and rolling soil in a maximum of eight inch (8 In) layers. Provide compaction density at a minimum ninety-five percent (95%) Standard Proctor ASTM D698-78 density. Make at least one (1) test per five hundred cubic yards (500 Cy) of embankment.
- K. Do not maneuver vehicles on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage to erosion and sedimentation control systems caused by construction traffic.
- L. Do not damage existing trees intended to remain.

3.18 REMOVAL OF CONTROLS

- A. Remove erosion and sediment controls when the site is finally stabilized or as directed by the Project Manager.

END OF SECTION

SWPPP INSPECTION FORM

City of Friendswood
Storm Water Pollution Prevention Plan
Construction Site Inspection Report

TPDES/EPA Permit Number: _____
COF Permit Number: _____
Date: _____

☐ No Exceptions noted.

If any of the following are checked they must be corrected prior to continuing work.

☐ Public Notice improperly posted.

☐ Initial Construction Site Inspection Report information requires updating.

☐ Copy of NOI not on site.

☐ Storm water pollution prevention plan not on site.

☐ Erosion and sediment controls improperly installed.

☐ Erosion and sediment controls improperly maintained.

☐ Fueling or washout areas not properly protected.

☐ Port-o-can or other sanitary facilities not properly protected.

☐ Self-inspection and maintenance records incomplete.

☐ Sediment from site outside area of construction.

☐ Other (see description below)

Once the above items have been corrected, call to arrange for re-inspection. No further inspections for any construction related activity shall be made until the above items have been corrected.

Inspector's Name

Contractor's Name

Inspector's Signature

Contractor's Signature

END OF DOCUMENT

01050-1

TPDES REQUIREMENTS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Documentation to be prepared and signed by the Contractor before conducting construction operations, in accordance with the Texas Pollutant Discharge Elimination system (TPDES) Construction General Permit Number TXR-150000 latest version from TCEQ.
- B. Implementation, maintenance inspection, and termination of storm water pollution prevention control measures including, but not limited to, erosion and sediment controls, storm water management plans, waste collection and disposal, off-site vehicle tracking, and other appropriate practices shown on the Drawings or specified elsewhere in the Contract Documents.
- C. Review of the Storm Water Pollution Prevention Plan (SWP3) implementation in a meeting with the Project Manager prior to start of construction.

1.2 DEFINITIONS

- A. Commencement of Construction Activities: The exposure of soil resulting from activities such as clearing, grading, and excavating.
- B. Large Construction Activity Project that:
 - 1. Disturbs five acres (5 Ac) or more, or
 - 2. disturbs less than five acres (5 Ac) but is part of a larger common plan of development that will disturb five acres (5 Ac) or more of land.
- C. Small Construction Activity Project that:
 - 1. Disturbs one or more acres (1+ Ac) but less than five acres (5 Ac), or
 - 2. disturbs less than one acre (1 Ac) but is part of a larger common plan of development that will ultimately disturb one or more acres (1+ Ac) but less than five acres (5 Ac).
- D. TPDES Operator:
 - 1. The person or persons who have day-to-day operational control of the construction activities which are necessary to ensure compliance with the SWP3 for the site or other Construction General Permit conditions.

1.3 REFERENCES

- A. CFCO – City of Friendswood Code of Ordinances.
 - 1. Ordinance 2005-01.
- C. TCEQ – Texas Commission on Environmental Quality.
 - 1. Texas Pollutant Discharge Elimination system (TPDES) Construction General Permit Number TXR-150000

PART II: PRODUCTS – NOT USED.

PART III: EXECUTION

- 3.1 SITE SPECIFIC STORM WATER POLLUTION PREVENTION PLAN (SWP3)
 - A. Prepare a SWP3 following Part III of the Construction General Permit in accordance with City Ordinance 2005-01.
 - B. Update or revise the SWP3 as needed during the construction following Part III, Section E of the Construction General Permit.
 - C. Submit the SWP3 and any updates or revisions to the Project Manager for review and address comments prior to commencing, or continuing, construction activities.
- 3.2 NOTICE OF INTENT (NOI) for Construction Activity
 - A. Submit a signed Notice of Intent (NOI) and fee electronically through the ePermitting system in STEERS at <https://www3.tceq.texas.gov/steers/> unless you qualify for an electronic waiver.
 - B. Submission of the Notice of Intent form by both the City and the Contractor to TCEQ is required a minimum of two (2) days before Commencement of Construction Activities.
- 3.3 CONSTRUCTION SITE NOTICE FOR LARGE CONSTRUCTION ACTIVITY
 - A. Complete the Large Construction Site Notice, located at: <https://www.tceq.texas.gov/assets/public/permitting/stormwater/txr15-large-primary.pdf>
 - B. Transmit the signed Construction Site Notice to the Project Manager at least seven days (7 D) prior to Commencement of Construction Activity.
- 3.4 CONSTRUCTION SITE NOTICE FOR SMALL CONSTRUCTION ACTIVITY
 - A. Complete the Small Construction Site Notice, located at: <https://www.tceq.texas.gov/assets/public/permitting/stormwater/txr15-small-site.pdf>
 - B. Transmit the signed Construction Site Notice to the Project Manager at least seven days (7 D) prior to Commencement of Construction Activity.
- 3.5 INSPECTIONS
 - A. Conduct inspections in accordance with TCEQ requirements. An electronic version of the Inspection Report Template is available at: <https://www.epa.gov/npdes/npdes-applications-and-forms-epa-forms>.
- 3.6 RECORDS RETENTION
 - A. Keep a copy of this document and the SWP3 in a readily accessible location at the construction site from Commencement of Construction Activity until the submission of the Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under TPDES Construction General Permit (TXR 150000). The Contractors with day-

to-day operational control over SWP3 implementation shall have a copy of the SWP3 available at a central location, on-site, for the use of all operators and those identified as having responsibilities under the SWP3. Upon submission of the NOT, submit all required forms and a copy of the SWP3 with all revisions to the Project Manager.

3.7 REQUIRED NOTICES

- A. Post the following notices from the effective date of the SWP3 until the date of final site stabilization as defined in the Construction General Permit:
 - 1. Post the TPDES permit number for Large Construction Activity or a signed TCEQ Construction Site Notice for Small Construction Activity. Signed copies of the City's and the Contractor's NOI must also be posted.
 - 2. Post notices near the main entrance of the construction site in a prominent place for public viewing. Post name and telephone number of the Contractor's local contact person, brief project description and location of the SWP3.
 - a. If posting near a main entrance is not feasible due to safety concerns, coordinate posting of notice with the Project Manager to conform to requirements of the Construction General Permit.
 - b. If the Project is a linear construction project (e.g.: road, utilities, etc.), post notice in a publicly accessible location near active construction. Move notice as necessary.
- C. Post a notice to equipment and vehicles operators, instructing them to stop, check, and clean tires of debris and mud before driving onto traffic lanes. Post at each stabilized construction exit area.
- D. Post a notice of waste disposal procedures in a readily visible location on site.

3.8 ON-SITE WASTE MATERIAL STORAGE

- A. On-site waste material storage shall be self-contained and shall satisfy appropriate local, state, and federal rules and regulations.
- B. Prepare list of waste material to be stored on-site. Update list as necessary to include up-to-date information. Keep a copy of updated list with the SWP3.
- C. Prepare description of controls to reduce pollutants generated from on-site storage. Include storage practices necessary to minimize exposure of materials to storm water, and spill prevention and response measures consistent with best management practices. Keep a copy of the description with the SWP3.

3.9 NOTICE OF CHANGE (NOC) for Construction Activity

- A. Submit a Notice of Change (NOC) electronically through the ePermitting system in STEERS at <https://www3.tceq.texas.gov/steers/> within ten days (10 D) prior to the change in Operator status.

3.10 NOTICE OF TERMINATION (NOT) for Construction Activity

- A. Submit a Notice of Termination (NOT) electronically through the ePermitting system in STEERS at <https://www3.tceq.texas.gov/steers/> within thirty (30 D) after:
 - 1. Final stabilization has been achieved on all portions of the site that are the responsibility of the Contractor; or
 - 2. Another operator has assumed control over all areas of the site that have not been stabilized; and
 - 3. All silt fences and other temporary erosion controls have been removed, scheduled to be removed as defined in the SWP3, or transferred to a new operator if the new operator has sought permit coverage.
- B. The Project Manager shall complete the City's NOT and submit the Contractors and the City's notices to the TCEQ and MS4 entities.

END OF DOCUMENT

PROJECT SIGNAGE

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Requirements for furnishing, fabricating and installing non-reflectorized plywood project signs.
- B. Requirements for furnishing, fabricating and installing various interior and exterior aluminum and plastic signs.
- C. Installation of aluminum reflectorized street signage.
- D. Commemorative Plaques.

1.2 PAYMENT AND MEASUREMENT

- A. Unit Prices:
 - 1. Payment for Project Signs shall be per each sign, which shall be full compensation for sign blanks, fabrication of the sign, signposts, all mounting hardware, washing, cleaning, repairing, all incidentals needed to furnish, fabricate and erect sign, and removal of the sign.
 - 2. Payment for signage in buildings shall be on an allowance basis.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for Work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

- A. APA – The Engineered Wood Association.
- B. ASTM – American Society for Testing and Materials.
 - 1. ASTM A 153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 2. ASTM A 307 – Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - 3. ASTM B 209 – Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - 4. ASTM B 449 – Standard Specification for Chromates on Aluminum.
 - 5. ASTM B 695 – Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 - 6. ASTM D 4956 – Standard Specification for Retroreflective Sheeting for Traffic Control.
- C. Canadian Council of Forest Industries (COFI).
- E. TxDOT – Texas Department of Transportation.
 - 1. Compliant Work Zone Traffic Control Devices (CWZTCD), latest edition.
 - 2. Department of Materials Specification DMS-7100 Plywood Sign Blanks.

3. Department of Materials Specification DMS-7110 Aluminum Sign Blanks.
 4. Department of Materials Specification DMS-8300 Sign Face Materials.
 5. Standard Specifications for Construction of Highways, Streets and Bridges Item 634 – Plywood signs (Type A).
 6. Standard Specifications for Construction of Highways, Streets and Bridges Item 636 – Aluminum Signs (Type A).
 7. Texas Manual on Uniform Traffic Control Devices (TMUTCD), Latest Edition.
- F. U.S. Product Standards PS – 1.

1.4 SUBMITTALS

- A. Submit manufacturers' product data for following items for approval for each type of signage specified in this Section.
- B. Submit shop drawings and proofs for Interior and Exterior signage and Commemorative Plaque.
- C. Submit manufacturer's certification that all signage meets requirements in this Specification.

PART II: PRODUCTS

2.1 PLYWOOD SIGN BLANKS

- A. Plywood signs shall conform to Item 634 of the "Texas Department of Transportation Standard Specifications for Construction of Highways, Streets and Bridges" ("TxDOT") and TxDOT Department of Materials Specification DMS-7100.
- B. Plywood blanks shall be five-eighths (5/8) inch thick. Plywood shall be smooth, weather-resistant, of one (1) piece construction and free of scarf or finger joints.
- C. Plywood shall bear legible grade markings of APA – The Engineered Wood Association or the Canadian Council of Forest Industries (COFI) and shall meet the following requirements:
 1. Use plywood that is natural in color or the color approved by the Project Manager.
 2. Classification of Species shall be a group one (1) species classification.
 3. Exposure Durability Classification shall be for exterior.
 4. Use Grade B or better for face and back veneers.
 5. Inner plies shall be:
 - a. Grade B jointed or
 - b. Grade C plugged jointed
 6. Inner ply gaps:
 - a. Do not exceed three-eighths (3/8) inch for any gaps between adjacent pieces of jointed inner ply and do not exceed three-sixteenths (3/16) inch for average of all

- gaps in a panel.
- b. Do not exceed four (4) core gaps and edge splits per eight (8) feet of cross-band layer.
- 7. Use overlay sheets on both sides of the plywood panel of high density material that meets or exceeds the latest revision of U.S. Product Standards PS – 1.
- 8. Plywood shall maintain a flatness that shall not deviate from a plane surface by more than two (2) inches.
- 9. Sign blanks shall be of one continuous piece of plywood and shall not be spliced.
- 10. Plywood blanks shall be used for Temporary or Construction Traffic Signage only.

2.2 ALUMINUM SIGN BLANKS

- A. Aluminum sheet or coil sign blanks shall meet all requirements of TxDOT Standards Specification Item 635, TxDOT DMS-7110 Aluminum Sign Blanks and ASTM B 209, Alloys 6061-T-6 or 5052-H38.
- B. Sign blanks made from sheet or coil shall be free of buckles, warps, dents, cockles, burrs and other defects and must be a plane surface. Sign blank thickness shall be eight-hundredths (0.08) inch.
- C. Treat all sign blanks fabricated from sheet and coil with a chromate chemical process resulting in a coating meeting the requirements of ASTM B 449, Class 2. The coating shall be light colored, tight and free from powdery residues.
- D. Manufacturer shall furnish mill test reports for aluminum sheet or coil which reflect the chemical and physical properties of the aluminum.

2.3 SIGN MOUNTING HARDWARE AND ADHESIVES

- A. All material for sign posts and mounting hardware shall be galvanized steel and be in compliance with ASTM A307, ASTM A153 and ASTM B695.
- B. Sign posts shall be galvanized steel two and three-eighths (2-3/8) inch outside diameter.
- C. Sign Post mounting shall be “Pos-Lok” or equal system consisting of sixteen (16) inch sleeve and removable wedge.
- D. Pipe and post clamp castings and miscellaneous fasteners shall be verified by manufacturer’s certifications stating that the material meets all applicable requirements.
- E. Interior signage shall either use fasteners or bond adhesive to fasten sign to the wall.
- F. Exterior signage and plaque shall have studs on back of signage and use either cement or bonding agent.

2.4 FACE MATERIALS

- A. All materials are to be certified by lot or shipment that material supplied meets requirements listed in this Specifications. Material shall also

comply with ASTM D4956 and TxDOT DMS 8300.

- B. Sign face materials shall be processed, applied and stored according to the manufacturer's recommendations. Sign face materials shall perform for a minimum of ten (10) years.
- C. The Project Manager shall reject any sign and/or face material for the following reasons:
 - 1. Cracks discernible with the unaided eye from the driver's position while in an outside lane at a distance of fifty (50) feet or greater from the sign;
 - 2. Peeling in excess of one-quarter (1/4) inch;
 - 3. Shrinkage in excess of one-eighth (1/8) inch total per forty-eight (48) inches of sheeting width
 - 4. Fading or loss of color to the extent that color fails to meet the requirements of ASTM D 4956 or TxDOT DMS 8300;
 - 5. In non-construction zone – loss of reflectivity to a level eighty (80) percent of the minimum values as specified in ASTM D 4956;
 - 6. In construction zone – loss of reflectivity to a level sixty (60) percent of the minimum values as specified in ASTM D 4956; or
 - 7. Consist of pressure activated material of diamond or prismatic vinyl.
- D. Any sign face that does not conform to this Section shall be rejected, and the Contractor shall replace it with no additional cost to the City.

2.5 INTERIOR BUILDING SIGNAGE

- A. All interior signs shall be made of intergraded photo-etched plastic, with letters either raised or etched. All interior signage shall be ADA compliant and shall include at the bottom of the sign Grade 2 Braille raised one-thirty-seconds (1/32) inch.

2.6 EXTERIOR BUILDING SIGNAGE

- A. Raised lettering and numbers on the exterior of buildings shall be of the type and size shown in the Drawings and approved by the Project Manager.
- B. Acceptable sign materials shall be one (1) of the following:
 - 1. Anodized Aluminum, satin finish.
 - a. Color shall be either clear satin or;
 - b. Medium Bronze or;
 - c. Dark Bronze
 - 2. Bronze finish
 - a. Color shall be either natural satin or;
 - b. Oxidized Bronze or;
 - c. Dark Oxidized
 - 3. Plastic or Acrylic
 - a. Color shall compliment the building finish and to be selected by the City.

2.7 PROJECT SIGN

- A. Projects signs shall use materials as stated in paragraphs 2.1 and 2.4. Signs using non-reflective facing shall be in conformance with the City's Sign Ordinance. Sign post shall be painted non-reflective white.
- B. Project sign shall have the following information:
 - 1. City of Friendswood Seal
 - 2. Words "City of Friendswood"
 - 3. Project Name
 - 4. Design Professional Name and address
 - 5. Contractor Name, address and phone number
 - 6. Name of Mayor, City Council and City Manager
 - 7. City contact information
- C. Proof shall be approved by the Project Manager before sign is made. If the Contractor has the sign made without the approval of the Project Manager, the Contractor shall replace at no additional cost to the City. See Figure 4.1 of this Section for typical project sign.

2.8 COMMEMORATIVE PLAQUE

- A. Commemorative plaques shall be made of either brass or bronze. Finish shall be either dark oxidized or light oxidized. Lettering shall have satin finish.
- B. Commemorative plaque shall be either eighteen (18) inches wide by twenty-four (24) inches tall, or twenty-four (24) inches wide by eighteen (18) inches tall.
- C. Commemorative plaque shall have the following information:
 - 1. City of Friendswood Seal
 - 2. Words "City of Friendswood"
 - 3. Project Name
 - 4. Name of Mayor, City Council and City Manager at the time that the Project was funded and approved for construction.
 - 5. Year the construction was completed.
 - 6. Optional emblem of Sponsor Department.

2.9 TEMPORARY SIGN POSTS

- A. Sign posts shall be either:
 - 1. Four (4) inch by four (4) inch Pressure Treated Lumber. Sign posts shall be painted non-reflective white. Timber post shall be used for temporary construction and temporary projects signs only, no exceptions.
 - 2. One and seven-eighths square galvanized metal tubing (SGMT), with seven-sixteenths (7/16) holes punched on one (1) inch centers. SGMT and mounting shall conform to the TxDOT Construction Work Zone Traffic Control Devices (CWTZTD). This sign post shall be used for temporary construction signs only, no exceptions.

- B. Posts shall be installed as specified in Paragraph 3.2.A.2.a or other method approved by the Project Manager.

PART III: EXECUTION

3.1 GENERAL

- A. Installation of signs shall be in compliance with current City of Friendswood Sign Ordinance.
- B. All signs shall be installed at the locations directed by the Project Manager.

3.2 TRAFFIC SIGNS

- A. All traffic signs, whether permanent or temporary, and their installation shall be accordance with the latest edition of the “Texas Manual on Construction Traffic Control Devices” (TMUTCD), and “Construction Work Zone Traffic Control Devices” (CWZTCD).

1. Permanent Signs

- a. Permanent traffic sign posts mounting device shall be set a minimum of two (2) foot – six (6) inches in depth in a twelve (12) inch diameter hole filled with Class C concrete to within three (3) inches below finished grade.
- b. Mounting wedge shall extend two (2) inches above natural grade.
- c. Bottom of sign shall be a minimum of seven (7) feet above natural or finished grade or above top of curb/edge of pavement, whichever is higher.
- d. Side of sign closest to traffic shall be a minimum of two (2) feet from either back of curb or edge of pavement.

2. Temporary Traffic Sign

- a. Temporary construction posts shall be set a minimum of three (3) feet in depth in a twelve (12) inch diameter hole filled with either sand or natural ground which shall be compacted to ninety-five (95) percent density.
- b. Bottom of sign shall be a minimum of seven (7) feet above natural or finished grade or above top of curb/edge of pavement, whichever is higher.
- c. Side of sign closest to traffic shall be a minimum of two (2) feet from either back of curb or edge of pavement.
- d. Signs shall be maintained, cleaned and repaired as needed during the construction of the project.
- e. Signs shall be permitted and installed on the right-of-way where designated by the Project Manager or Traffic Control Plan.
- f. The signs shall become the property of the Contractor and shall be removed at the completion of the project.

3.3 PROJECT SIGN

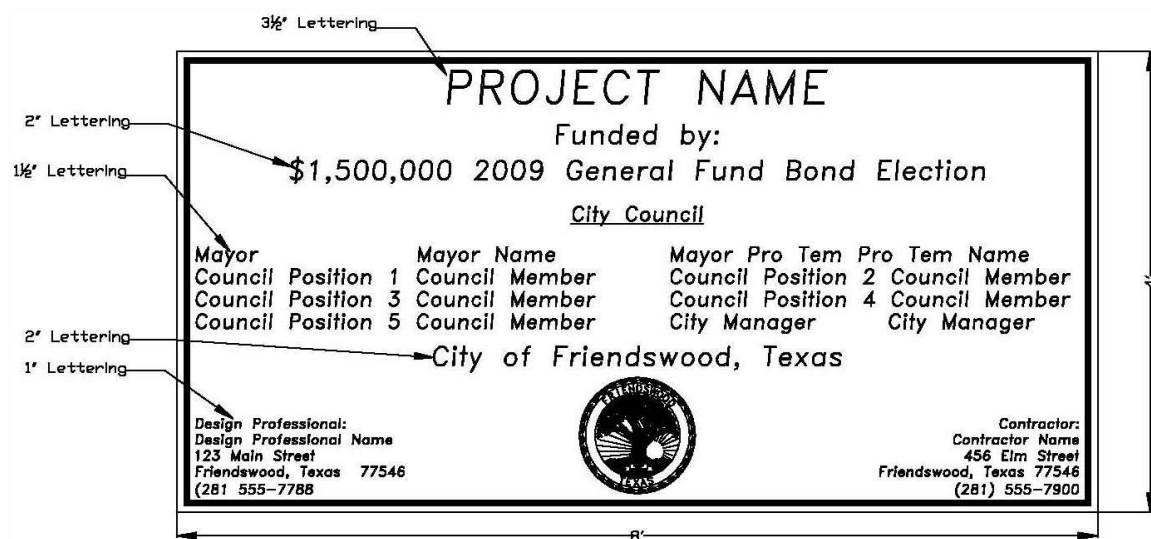
- A. project sign posts shall be set a minimum of three (3) feet in depth in a twelve (12) inch diameter hole filled with either sand or natural ground which shall be compacted to ninety-five (95) percent density.
- B. Project signs shall be mounted so that the top of the sign does not exceed eight (8) feet above natural ground.
- C. There shall be two (2) signs for street, drainage and utility improvements or one (1) sign for public facility projects.
- D. Signs shall be maintained, cleaned and repaired as needed during the construction of the project.
- E. Signs shall be permitted and installed on the right-of-way or the project site where designated by the Project Manager or Traffic Control Plan.
- F. The signs shall become the property of the Contractor and shall be removed at the completion of the project.

3.4 INTERIOR AND EXTERIOR SIGNS AND COMMEMORATIVE PLAQUE.

- A. Interior and exterior signs and Commemorative Plaque shall be installed in conformance with all specifications in this Section.
- B. All protective coatings or materials shall remain in place until facility is accepted.

PART IV: FIGURES

4.1 TYPICAL PROJECT SIGN



END OF SECTION

UTILITY IDENTIFICATION MARKINGS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Markings that identify utilities during construction.
- B. Markings that identify water, sanitary sewer, and storm manholes, valves, meters and cleanouts.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment shall be made for marking utilities during and after new construction or repair under this Section.

1.3 REFERENCES

- A. APWA – American Public Works Association.
 - 1. APWA – Recommended Marking Guidelines for Underground Utilities.

1.4 SUBMITTALS

- A. Submit manufacturer's product data concerning following materials for approval on type of marking paint being used.

PART II: PRODUCTS

2.1 PAINT FOR UTILITY IDENTIFICATION FOR EXCAVATIONS

- A. Krylon Industrial Quik-Mark Solvent Based Inverted Marking Paint complying with APWA Recommendations or approved equal.

2.2. Markings for identification of newly installed utilities.

- A. Krylon Industrial Quik-Mark Solvent-Based Inverted Marking Paint complying with APWA Recommendations or approved equal. The following colors shall be used for potable water and sanitary sewer:
 - 1. Potable Water: Krylon Industrial Quik-Mark Solvent-Based Inverted Marking Paint SO3903 or equivalent approved by the City's Project Manager.
 - 2. Sanitary Sewer: Krylon Industrial Quik-Mark Solvent-Base Inverted Marking Paint SO3904 or equivalent approved by the City's Project Manager.
- B. Storm Sewer Manhole markings shall use Krylon Industrial Quik-Mark Solvent Based Paint or equivalent approved by the City's Project Manager.

PART III: EXECUTION

3.1 PREPARATION

- A. Accurately locate and install approved markers to conform to classes and colors indicated in this Section.
- B. Clean and repair surfaces to receive markings. Remove loose material, dust and contaminants such as oil, curing membrane or polished aggregates.

3.2 INSTALLATION

- A. Utility markings for excavation purposes shall be single line and have symbols approved by the APWA.
- B. See City of Friendswood Standard Marking Details for examples of new utility markings.
- C. Saw-cut curb or edge of pavement so that the saw-cut length matches the length as specified below. Saw-cut shall be a minimum of four inches (4 In) in length by one-quarter inch (1/4 In) in width by one-eighth inch (1/8 In) in depth.
- D. Markings for newly installed utilities shall comply with the following:
 - 1. Water Valves shall be marked by a nine inch (9 In) long by six inch (6 In) wide blue marker, using Krylon SO3903 marking paint and shall be perpendicular to the centerline of the road.
 - 2. Water Meters shall be marked by a nine inch (9 In) long by three inch (3 In) wide blue marker, using Krylon SO3903 marking paint and shall be perpendicular to the centerline of the road.
 - 3. Sanitary Sewer Manholes shall be marked by a nine inch (9 In) long by six inch (6 In) wide green marker, using Krylon SO3904 marking paint and shall be perpendicular to the centerline of the road.
 - 4. Sanitary Sewer Clean-outs shall be marked by a nine inch (9 In) long by three inch (3 In) wide green marker, using Krylon SO3904 marking paint and shall be perpendicular to the centerline of the road.
 - 5. Storm Sewer Manholes shall be marked by a nine inch (9 In) long by three inch (3 In) wide black marker, using Krylon SO3550 marking paint and shall be parallel to the centerline of the road.

3.4 WARRANTY

- A. Warrant material and labor for period of twelve months (12 Mos) from date of installation of markings.

END OF SECTION

TEMPORARY FACILITIES AND CONTROLS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Temporary facilities and necessary controls for the Project, including utilities, telephone, sanitary facilities, storage sheds and building, safety requirements, first aid equipment, fire protection, security measures, protection of the Work and property, access roads and parking, environmental controls, pest and rodent control and disposal of trash, debris and excavated material.
- B. Facilities and controls specified in this Section are considered minimum for the Project. Provide additional facilities and controls for proper execution of the Work and to meet the Contractor's responsibilities for protection of persons and property.

1.2 CONTRACTOR'S RESPONSIBILITY

- A. Comply with applicable requirements specified in other sections of the Technical Specifications.
 - 1. Maintain and operate temporary facilities and systems to assure continuous service.
 - 2. Modify and extend systems as the Work progress requires.
 - 3. Completely remove temporary materials and equipment when no longer required.
 - 4. Restore existing facilities used for temporary services to specified or original condition.

1.3 REFERENCES

- A. CFCO – City of Friendswood Code of Ordinances.
 - 1. Chapter 54, Article IV – Noise.
- B. CFR – Code of Federal Regulations.
 - 1. CFR 29 Part 1926 – Safety and Health Regulations for Construction.
- D. TOSA – Texas Occupational Safety Act.
 - 1. Texas Occupational Safety Act Article 51 82a, V.C.S.

PART II: PRODUCTS – NOT USED.

PART III: EXECUTION

3.1 TEMPORARY UTILITIES

- A. Obtaining Temporary Service:
 - 1. Make arrangements with utility service companies for temporary services.
 - 2. Abide by rules and regulations of the utility service companies or authorities having jurisdiction.

3. Be responsible for utility service costs until Date of Substantial Completion. Included are fuel, power, light, heat, and other utility services necessary for execution, completion, testing, and initial operation of the Work.
- B. Water:
 1. Provide water required for and in connection with work to be performed and for specified tests of piping, equipment, devices, or for other use as required for proper completion of the Work.
 2. Water to be drawn from public fire hydrants. Obtain transit meter from City of Friendswood, Department of Public Works. Pay required deposit.
 3. Provide and maintain an adequate supply of potable water for domestic consumption by the Contractor's personnel, the Project Manager and representatives of the City.
- C. Electricity and Lighting:
 1. Provide electric power service required for the Work including required testing, lighting, operation of equipment, and other Contractor use.
 2. Electric power service includes temporary power or generators required to maintain plant operations during scheduled shutdowns.
 3. Minimum lighting level shall be ten foot-candles (10 fc) for open areas; twenty foot-candles (20 fc) for stairs and shops. Provide a minimum of one (1) – three hundred watt (300w) lamp for each two hundred square feet (200 Sf) of work area.
- D. Temporary Heat and Ventilation:
 1. Provide temporary heat necessary for protection or completion of the Work.
 2. Provide temporary heat and ventilation to assure safe working conditions; maintain enclosed areas at a minimum of fifty degrees Fahrenheit (50° F).
- E. Telephone:
 1. Provide emergency telephone service at the Project site for use by the Contractor's personnel and others performing work or furnishing services at the site.
 2. Provide Houston-Metro lines, allowing unlimited calls, without charge in Greater Houston Metropolitan area with "call waiting" and "call forwarding" options. Provide one (1) telephone answering machine with beeperless remote message retrieval capability.
- F. Sanitary Facilities:
 1. Provide and maintain sanitary facilities for persons on the site; comply with regulations of State and local departments of health.
 2. Enforce use of sanitary facilities by construction personnel at site. Enclose sanitary facilities. Pit-type toilets are not permitted. No discharge will be allowed from these facilities. Collect and store sewage and waste so as not to cause nuisance or health

problems. Haul sewage and waste off-site and properly dispose in accordance with applicable regulations. Sewage shall not be disposed of on-site, buried or introduced into the Storm Water System.

3. Locate portable toilets near the Work site and secluded from view insofar as possible. Portable toilets shall be installed on level ground, twenty feet (20 Ft) away from nearest downslope stormdrain inlet and shall be a minimum of eleven feet (11 Ft) behind curbs or top slopes of open ditch streets.
4. Portable toilets shall have a secondary containment system, either a containment pan or berm with ten (10) mil polyethylene. Portable toilets shall be secured to the ground so as not to tip over during windstorms. All spillage shall be pumped out immediately.
5. Keep portable toilets clean and supplied throughout the course of the Work. Portable toilets shall be transported to and from site, maintained and sewage hauled by a Contractor licensed by the State of Texas. All facilities shall be checked weekly and shall have services dates, owner identification and contact information in a prominent place.

3.2 STORAGE SHEDS AND BUILDINGS

- A. Provide adequately ventilated, watertight storage facilities with floor above ground level for Products susceptible to weather damage.
- B. Storage of Products not susceptible to weather damage may be on blocks off the ground.
- C. Store Products in a neat and orderly manner. Place Products to permit easy access for identification, inspection and inventory.
- D. Fill and grade site for temporary structures to provide drainage away from temporary and existing buildings.

3.3 SAFETY REQUIREMENTS

- A. Submit a safety program at the pre-construction meeting and follow the program in accordance with Section 00500 – General Conditions. Include documented response to trench safety requirements of Section 02280 – Trench Safety System.
- B. Conduct operations in strict accordance with applicable Federal, State and local safety codes and statutes and with good construction practice. Establish and maintain procedures for safety of all work, personnel and equipment involved in the Work.
- C. Observe and comply with Texas Occupational Safety Act (Art. 51 82a, V.C.S.) and with all safety and health standards promulgated by Secretary of Labor under Section 107 of Contract Work Hours and Standards Act, published in 29 CFR Part 1926 and adopted by Secretary of Labor as occupational safety and health standards under Williams-Steiger Occupational Safety and Health Act of 1970, and to other legislation enacted for safety and health of the Contractor employees.

Safety and health standards apply to Subcontractors and Suppliers as well as to the Contractor.

- D. Observance of and compliance with safety regulations is the Contractor's responsibility without reliance or superintendence of or direction by the Project Manager. Immediately advise the Project Manager of investigation or inspection by Federal Safety and Health inspectors of the Contractor's or Subcontractor's work or place of work on site under the Contract, and after investigation or inspection, advise the Project Manager of results. Submit one (1) copy of accident reports to Project Manager within ten days (10 D) of occurrence.
- E. Protect areas occupied by workmen using the best available devices for detection of lethal and combustible gases. Test devices frequently to assure functional capability. Constantly observe infiltration of liquids into the Work area for visual or odor evidence of contamination, and immediately take appropriate steps to seal off entry of contaminated liquids to the Work area.
- F. Implement safety measures, including but not limited to safety personnel, first-aid equipment, ventilating equipment and other safety equipment specified or detailed on the Drawings.
- G. Maintain required coordination with City Police and Fire Departments during entire period covered by the Contract.
- H. Include Project safety analysis in safety plan. Itemize major tasks and potential safety hazards. Plan to eliminate hazards or protect workers and public from each hazard.

3.4 FIRST AID EQUIPMENT

- A. Provide a first aid kit throughout the construction period. List telephone numbers for physicians, hospitals, and ambulance services in each first aid kit.
- B. Have at least one (1) person thoroughly trained in first aid and CPR procedures present on the site when work is in progress. The Contractor shall conform to protocols and requirements for training and protection against "blood borne pathogens".

3.5 FIRE PROTECTION

- A. Conform to specified fire protection and prevention requirements established by Federal, State, or local governmental agencies and as provided in Safety Program.

3.6 SECURITY MEASURES

- A. Protect the Work, materials, equipment, and property from loss, theft, damage, or vandalism. Protect the City property used in performance of the Contract.
- B. If existing fencing or barriers are breached or removed for purposes of construction, provide and maintain temporary security fencing equal to existing.

3.7 PROTECTION OF UTILITIES AND PIPELINES

- A. Prevent damage to existing public utilities during construction. Approximate locations of known utilities are shown on the Drawings, but all lines may not be shown. Excavate with caution and repair lines damaged by construction operations.
- B. Use the Utility Coordinating Committee One Call System, telephone number, (713) 223-4567, which must be called forty-eight hours (48 Hrs) in advance. The toll free telephone number is 1-800-669-8344, Texas One Call System.
 - 1. City Utilities that need to be located shall be done so after notification of the Project Manager and the Department of Public works at (281) 996-3380.
- C. Before excavating, locate underground utilities by appropriate means including the use of metal detection equipment, and probes, or by excavation or surveys. Repair damage caused by investigative work and by failure to locate or to preserve underground utilities.
- D. Give utility owners a minimum five days (5 D) notice before commencing excavation to allow time to locate utilities and make adjustments or relocations when they conflict with the Work. Include cost for temporary relocation of water, wastewater, and storm drainage lines, necessary to accommodate construction, in unit prices for utility construction unless otherwise noted. Bypassing of sanitary waste to storm drainage facilities is not allowed.
- E. Prior to excavation near pipelines, request a representative of the pipeline company to meet with the Contractor and the Project Manager at the site to discuss procedures to be used. Request pipeline company's representative to locate the pipelines in at least three (3) locations: at each side and at centerline of proposed excavation of proposed utility. Also request representative and the Project Manager to be present to observe the Contractor's operations when excavation is conducted within fifteen feet (15 Ft) of pipeline.

3.8 PROTECTION OF THE WORK AND PROPERTY

- A. Preventive Actions
 - 1. Take necessary precautions and actions to prevent damage, injury, or loss to the Work or public and private property, including:
 - a. Storage of apparatus, supplies, and Products in an orderly, safe manner to limit interference with progress of the Work or work of other contractors, utility service companies, or the City's operations.
 - b. Suitable storage for Products subject to damage by exposure to weather, theft, breakage, etc.
 - c. Limitation of loading pressures imposed upon portions of the Work.
 - d. Frequent clean up of refuse, scrap materials, and debris from construction operations, necessary to maintain the

- site in a safe and orderly condition.
 - e. Provision of barricades and guard rails to protect pedestrian and traffic around openings, scaffolding, temporary stairs and ramps, excavations, elevated walkways, and other hazardous areas.
 - 2. Protect public and private property adjacent to the site. Obtain written consent before entering or occupying privately-owned land except on easements provided for construction. Restore property damaged by construction operations to condition equal to or better than that existing before the damage.
 - B. Barricades and Warning Systems
 - 1. Where work is performed on or adjacent to roadways, rights-of-ways, or public land, provide barricades, fences, lights, warning signs, danger signals, and other precautionary measures necessary for protection of persons or property and for protection of the Work.
 - a. Erect sufficient barricades to keep vehicles and pedestrians from entering the Work. Paint barricades to be visible at night. From sunset to sunrise, provide at least one (1) light at each barricade.
 - b. Maintain barricades, signs, lights, and provide watchmen until the Project Manager approves removal. Whenever work creates encroachment onto public roadways, station flagmen to manage traffic flow in accordance with approved traffic control plan.
 - c. Conform to requirements of Section 01555 – Traffic Control and Regulation.
 - C. PROTECTION OF EXISTING STRUCTURES
 - 1. Underground Facilities
 - a. Known Underground Facilities are shown on the Drawings but all Facilities may not be shown. Explore sufficiently ahead of trenching and excavation work to locate Underground Facilities in order to prevent damage to them and to prevent interruption of utility services. Restore damage to Underground Facilities to original condition at no additional cost to the City.
 - b. If necessary to avoid unanticipated Underground Facilities, the Project Manager may make changes in location of the Work.
 - c. If permanent relocation of an Underground Facility is required and not provided for in the Contract documents, the Project Manager shall direct the Contractor in writing to perform the Work under Modification provisions in Section 00500 – General Conditions.
 - 2. Surface Structures include buildings, tanks, walls, bridges, roads, dams, channels, open drainage, piping, poles, wires, posts, signs, markers, curbs, walks, guard cables, fencing, and

- other facilities that are visible above the ground level.
3. Protection of Underground Facilities and Surface Structures:
 - a. Support in place and protect Underground Facilities and Surface Structures located within or adjacent to the limits of the Work from damage. Install supports as required by the owner of the structure. Satisfy the Project Manager that the owner of the facility or structure has approved methods and procedures before installing structure supports.
 - b. Avoid moving or changing public utility or private corporation property without prior written consent of a responsible official of the facility or structure. Allow representatives of utilities to enter the construction site for maintenance and repair purposes or to make necessary changes.
 - c. Notify utility and pipeline owners and operators of the nature of construction operations and dates when operations will be performed. When construction operations are required in immediate vicinity of existing structures, pipelines, or utilities, give a minimum of five working days (5 wD) advance notice. Probe and flag location of Underground Facilities prior to commencement of excavation. Keep flags in place until construction operations uncover the facility.
 - d. Assume risk for damages and expenses to Underground Facilities and Surface Structures within or adjacent to the Work.
 - D. Employ a structural engineer to ensure protection measures are adequate for the safety and integrity of structures and facilities.
 - E. Protection of Installed Products:
 1. Provide protection of Installed Products to prevent damage from subsequent operations. Remove protection facilities when no longer needed, prior to completion of the Work.
 2. Control traffic to prevent damage to Products and surfaces.
 3. Provide coverings to protect Products from damage. Cover projections, wall corners, jambs, sills, and exposed sides of openings in areas used for traffic and passage of materials in subsequent work.

3.9 ROADS AND PARKING

- A. Prevent interference with traffic and City operations on existing roads.
- B. Designate temporary parking areas to accommodate construction and the City personnel. When site space is not adequate, provide additional off-site Parking. Locate as approved by the Project Manager.
- C. Minimize use by construction traffic on existing streets and driveways.
- D. Do not allow heavy vehicles or construction equipment in existing parking areas.

3.10 ENVIRONMENTAL CONTROLS

- A. Use methods, equipment, and temporary construction necessary for control of environmental conditions at the site and adjacent areas.
- B. Comply with statutes, regulations, and ordinances relating to prevention of environmental pollution and preservation of natural resources including National Environmental Policy Act of 1969, PL 91-190, Executive Order 11514.
- C. Minimize impact to the surrounding environment. Do not use construction procedures that cause unnecessary excavation and filling of terrain, indiscriminate destruction of vegetation, air or stream pollution, or harassment or destruction of wildlife.
- D. Limit disturbed areas to boundaries established by the Contract. Do not pollute on-site streams, sewers, wells, or other water sources.
- E. Do not burn rubbish, debris or waste materials.

3.11 POLLUTION CONTROL

- A. Provide methods, means, and facilities necessary to prevent contamination of soil, water or the atmosphere by discharge of Pollutants from construction operations.
- B. Provide equipment and personnel to perform emergency measures to contain spillage, and to remove contaminated soils or liquids. Excavate and dispose of contaminated earth off-site in accordance with laws and regulations, and replace with suitable compacted fill and topsoil.
- C. Provide systems necessary for control of Pollutants.
 - 1. Prevent toxic concentrations of chemicals.
 - 2. Prevent harmful dispersal of Pollutants into the environment.
- D. Use equipment that conforms to current Federal, State, and local laws and regulations.

3.12 PEST AND RODENT CONTROL

- A. Provide rodent and pest control as necessary to prevent infestation of construction or storage areas.
- B. Employ methods and use materials that will not adversely affect conditions at site or on adjoining properties.

3.13 NOISE CONTROL

- A. Provide vehicles, equipment, and use construction activities that minimize noise to the greatest degree practicable. Conform to noise levels of Chapter 54, Article IV – Noise, City Code of Ordinances, and latest OSHA standards. Do not permit noise levels to interfere with the Work or create a nuisance to surrounding areas.
- B. Conduct construction operations during daylight hours except as approved by the Project Manager as specified in Section 1140 Paragraph 1.13.
- C. Select construction equipment that operates with minimum noise and vibration. When directed by the Project Manager, correct objectionable noise or vibration produced by operation of equipment at no additional

cost to the City.

- D. Sound Power Level (PWL) of equipment shall not exceed levels as specified in Chapter 54, Article IV, Section 54-95, City Code of Ordinances. Equipment noise requirements are contained in equipment specifications.

3.14 DUST CONTROL

- A. Use water or other methods approved by the Project Manager to control amount of dust generated by vehicle and equipment operations.

3.15 WATER RUNOFF AND EROSION CONTROL

- A. Comply with requirements of section 01410 -TPDES Requirements.
- B. Conduct fill, grading and ditching operations and provide adequate methods necessary to control surface water, runoff, subsurface water, and water from excavations and structures in order to prevent damage to the Work, the site, or adjoining properties.
 - 1. Plan and execute construction and earthwork by methods that control surface drainage from cuts and fills, and from borrow and waste disposal areas.
 - 2. Minimize area of bare soil exposed at one (1) time.
 - 3. Provide temporary control measures, such as berms, dikes, and drains.
 - 4. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.
 - 5. Construct fill and waste areas by selective placement of materials to eliminate erosion of surface silts or clays that may erode.
 - 6. Direct water away from excavations, pits, tunnels, and other construction areas to prevent erosion, sedimentation or damage.
 - 7. Maintain existing drainage patterns adjacent to the site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover.
 - 8. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to the site or adjoining areas, in conformance with environmental requirements.
 - 9. Inspect earthwork periodically to detect any evidence of erosion. Take corrective measures as required to control erosion.

3.16 CONCRETE WASHOUT PITS

- A. Temporary concrete washout facilities shall be located a minimum of fifty feet (50 Ft) from storm drain inlets, open drainage facilities and water courses. Each facility shall be located away from construction traffic or access to prevent disturbance or tracking.
- B. A sign shall be installed to inform concrete equipment operators, truck drivers and finishers to utilize proper facilities.
- C. Temporary washout facilities shall have a temporary pit or bermed area sufficient to completely contain all liquid and waste materials generated

during the washout procedures.

- D. Above grade washout area shall have a berm, with a base of straw hay bales staked with two (2) stakes per bale into the ground. The interior shall have a minimum of ten (10) mil polyethylene that shall be free of tears, holes or other defects. The minimum area of containment shall be ten foot by ten foot (10 Ft x 10 Ft) and shall have a minimum of four inches (4 In) of freeboard.
- E. Below grade washout area shall be surrounded with sandbags on the inner perimeter and silt filter fabric fence on the exterior perimeter. The pit shall be lined with a minimum of ten (10) mil polyethylene and have a minimum of twelve inches (12 In) of freeboard.
- F. All waste material shall be allowed to solidify before it is broken up and hauled off as specified in Section 01580 – Waste Material Disposal.

END OF SECTION

TRAFFIC CONTROL AND REGULATION

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Requirements for signs, signals, control devices, traffic barriers, flares, lights and traffic signals; construction parking control, designated haul routes, and bridging of trenches and excavations.
- B. Qualifications and requirements for use of flagmen.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price Contracts:
 - 1. Traffic control and regulation: Payment for traffic control and regulation is on a lump sum basis. Include preparation and submittal of traffic control plan if different than shown on the Drawings, and provision of traffic control devices, equipment, and personnel necessary to protect the Work and the public. Payment will be based on the Contractor's Schedule of Values for traffic control and regulation.
 - 2. Flagmen: Payment for flagmen is on a lump sum basis. Partial payments will be based on the Contractor's Schedule of Values for flagmen.
 - 3. New Portable Concrete Low Profile Traffic Barrier Provided: Payment is on a unit price basis for each linear foot of low profile traffic barrier provided, installed with hardware assemblies and connected together in accordance with the approved traffic control plan.
 - 4. Portable Concrete Low Profile Traffic Barrier Installed: Payment is on a unit price basis for each linear foot of low profile traffic barrier delivered to the project location, installed with hardware assemblies and connected together in accordance with the approved traffic control plan.
 - 5. Portable Concrete Low Profile Traffic Barrier Moved and Reset: Payment is on a unit price basis for each linear foot of low profile traffic barrier disassembled, moved on the project, reset at the new locations and connected together. Include cost to repair roadway in the unit price.
 - 6. Portable Concrete Low Profile Traffic Barrier Removed: Payment is on a unit price basis for each linear foot of low profile traffic barrier removed from the project, including hardware assemblies, and stockpiling at location listed in Section 01110 – Summary of Work. Include cost to repair roadway in the unit price.
 - 7. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price Contracts.

1. Include payment for work under this Section in the Total Stipulated Price.

1.3 REFERENCES

- A. TCCP – Texas Code of Criminal Procedure.
 1. Article 2.12, Texas Code of Criminal Procedure.
- B. TMUTCD – Texas Manual on Uniform Traffic Control Devices.
- C. TVCAS – Texas Vernon’s Civil Annotated Statutes.
 1. Article 4413 (29bb), commonly referred to as Private Investigators and Private Security Agencies Act.

1.4 SUBMITTALS

- A. Traffic control plan:
 1. If using traffic control plan contained in the Contract without modification, submit a letter confirming use of the plan.
 2. If using a different traffic control plan, submit the plan for approval. The plan must conform to TMUTCD requirements and be sealed by a Professional Engineer licensed by the State of Texas.
- C. Submit records verifying qualifications of Uniformed Peace Officers and Certified Flagmen proposed for use on the Work.

1.5 FLAGMEN

- A. Use Uniformed Peace Officers and Certified Flagmen to control movement of vehicular and pedestrian traffic when construction operations encroach on public traffic lanes.
- B. Uniformed Peace Officer: Individual employed full-time as a peace officer who receives separate compensation as a privately employed flagman. Private employment may be an employee-employer relationship or on an individual basis. Flagman may not be in the employ of another peace officer nor be a reserve peace officer.
 1. Uniformed Peace Officers may be:
 - a. Sheriffs and their deputies;
 - b. Constables and deputy constables;
 - c. Marshals or police officers of an incorporated city, town or village; or
 - d. as otherwise provided by Article 2.12, Code of Criminal Procedure.
 2. The Uniformed Peace Officer must be a full-time peace officer, must work a minimum average of thirty-two (32) paid hours per week, and must be paid a rate not less than the prevailing minimum hourly wage rate set by the federal Wage and Hour Act. The individual must be entitled to vacation, holidays, and insurance and retirement benefits.
- C. Certified Flagman: Individual who receives compensation as a flagman and meets the following qualifications:
 1. Formally trained and certified in traffic control procedures.

2. Shall speak English fluently. Ability to speak Spanish is desirable but not required.
3. Paid for flagman duty at an hourly rate not less than the wage rate set by the Davis-Bacon Act.
- D. Certified Flagmen must wear a distinctive uniform, bright-colored vest, and be equipped with appropriate flagging and communication devices while at the Work site. They must also have in their possession while on duty, a proof of training identification card issued by the appropriate training institute.

PART II: PRODUCTS

2.1 SIGNS, SIGNALS, AND DEVICES

- A. Comply with TMUTCD requirements.
- B. Traffic cones and drums, flares and lights: Conform to local jurisdictions' requirements.

2.2 PORTABLE LOW PROFILE CONCRETE BARRIERS

- A. The low profile concrete barrier is a patented design. Information concerning this barrier may be obtained from Texas Transportation Institute, Texas A&M University System, College Station, Texas 77843-3135, (409) 845-1712.

PART III: EXECUTION

3.1 PUBLIC ROADS

- A. Submit requests forms for lane closure and sidewalk closure to the City's Community Development Department at least three working days (3 wD) prior to need for blocking vehicular lanes or sidewalks. Do not block lanes or sidewalks without approved permits.
- B. Follow laws and regulations of governing jurisdictions when using public roads. Pay for and obtain permits from jurisdiction before impeding traffic or closing lanes. Coordinate activities with the Project Manager.
- C. Give the Project Manager one week (1 Wk) notice before implementing approved traffic control phases. Inform local businesses of impending traffic control activities.
- D. Notify police department, fire department, local schools, churches, and businesses in writing a minimum of five working days (5 wD) prior to beginning work.
- E. Maintain ten foot (10 Ft) wide all-weather lanes adjacent to the Work for emergency vehicle use. Keep all-weather lanes free of construction equipment and debris.
- F. Do not obstruct normal flow of traffic from 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. on designated major arterials or as directed by the Project Manager.

- G. Maintain local driveway access to residential and commercial properties adjacent to work areas at all times. Use all-weather materials approved by the Project Manager to maintain temporary driveway access to commercial and residential driveways.
- H. Keep streets entering and leaving job site free of excavated material, debris, and foreign material resulting from construction operations in compliance with applicable ordinances.
- I. Remove existing signage and striping that conflict with construction activities or that may cause driver confusion.
- J. Provide safe access for pedestrians along major cross streets.
- K. Alternate closures of cross streets so that two (2) adjacent cross streets are not closed simultaneously.
- L. Do not close more than two (2) consecutive esplanade openings at a time without prior approval from the Project Manager.

3.2 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and the City's operations.
- B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.3 FLARES AND LIGHTS

- A. Provide flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

3.4 HAUL ROUTES

- A. Utilize haul routes designated by authorities or shown on the Drawings for construction traffic.
- B. Confine construction traffic to designated haul routes.
- C. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

3.5 TRAFFIC SIGNS AND SIGNALS

- A. Construct necessary traffic control devices for temporary signals required to complete the Work including loop detectors, traffic signal conduits, traffic signal wiring and crosswalk signals.
- B. Install and operate traffic control signals to direct and maintain orderly traffic flow in areas under the Contractor's control affected by the Contractor's operations. Post notices, signs and traffic controls before moving into next phase of traffic control.
- C. Relocate traffic signs and signals as the Work progresses to maintain effective traffic control.
- D. Unless otherwise approved by the Project Manager, provide driveway signs with name of business that can be accessed from each crossover. Use two (2) signs for each crossover.

- E. Replace existing traffic control devices in the work area.
- F. The Project Manager may direct the Contractor to make minor adjustments to traffic control signage to eliminate driver confusion and maintain orderly traffic flow during construction at no additional cost to the City.

3.6 BRIDGING TRENCHES AND EXCAVATIONS

- A. When necessary, construct bridges over trenches and excavation to permit an unobstructed flow of traffic across construction areas and major drives. Use steel plates of sufficient thickness to support H-20 loading and install to operate with minimum noise.
- B. Shore trench or excavation to support bridge and traffic.
- C. Secure bridging against displacement with adjustable cleats, angles, bolts or other devices when:
 - 1. bridging is placed over existing bus routes,
 - 2. more than five percent (5%) of daily traffic is comprised of commercial or truck traffic,
 - 3. more than two (2) separate plates are used for bridging, and
 - 4. when bridge is to be used for more than five (5) consecutive days.
- D. Extend steel plates used for bridging a minimum of one foot (1 Ft) beyond edges of trench or excavation. Use temporary paving materials such as premix to feather edges of plates to minimize wheel impact on secured bridging.

3.7 REMOVAL

- A. Remove equipment and devices when no longer required.
- B. Repair damage caused by installation.
- C. Remove post settings to a depth of two feet (2 Ft).

3.8 TRAFFIC CONTROL, REGULATION AND DIRECTION

- A. Use Flagmen to control, regulate and direct an even flow and movement of vehicular and pedestrian traffic, for periods of time as may be required to provide for public safety and convenience, where:
 - 1. multi-lane vehicular traffic must be diverted into single lane vehicular traffic,
 - 2. vehicular traffic must change lanes abruptly,
 - 3. construction equipment must enter or cross vehicular traffic lanes and walks,
 - 4. construction equipment may intermittently encroach on vehicular traffic lanes and unprotected walks and crosswalks,
 - 5. traffic regulation is needed due to rerouting of vehicular traffic around the work site, and
 - 6. where construction activities might affect public safety and convenience.
- B. Use of Flagmen to assist in the regulation of traffic flow and movement does not relieve the Contractor of responsibility to take other means

necessary to protect the Work and the public.

- C. Flagmen shall use stop/slow signs to regulate traffic around construction areas. Flags shall not be allowed, unless flagmen are trained in the proper use and techniques.

3.9 INSTALLATION STANDARDS

- A. Place temporary pavement for single lane closures, in accordance with TMUTCD.
- B. Reinstall temporary and permanent pavement markings as approved by the Project Manager. When weather conditions do not allow application according to manufacturer's requirements, alternate markings may be considered. Submit proposed alternate to the Project Manager for approval prior to installation. No additional payment will be made for use of alternate markings.

3.10 MAINTENANCE OF EQUIPMENT AND MATERIAL

- A. Submit name, address and telephone number of individual designated to be responsible for maintenance of traffic handling at construction site to the Project Manager. Individual must be accessible at all times to immediately correct deficiencies in equipment and materials used to handle traffic including missing, damaged, or obscured signs, drums, barricades, or pavement markings.
- B. Inspect signs, barricades, drums, lamps and temporary pavement markings daily to verify that they are visible, in good working order, and conform with traffic handling plans as approved by the Project Manager. Immediately repair, clean, relocate, realign, or replace equipment or materials that are not in compliance.
- C. Keep equipment and materials, signs and pavement markings, clean and free of dust, dirt, grime, oil, mud, or debris.
- D. Obtain approval of the Project Manager to reuse damaged or vandalized signs, drums, and barricades.

END OF SECTION

QUALITY CONTROL TESTING PROCEDURES

PART I: GENERAL

1.1 QUALIFICATION OF LABORATORY

- A. Meet laboratory requirements of ASTM E329 and applicable requirements of ASTM C1077, ASTM D3666, and ASTM D3740.
- B. Meet ISO/TEC Guide 17025 conditions for accreditation by the American Association for Laboratory Accreditation (A2LA) in specific fields of testing required in individual Technical Specification sections.
- C. If laboratory subcontracts are part of the testing services, such work shall be placed with a laboratory complying with the requirements of this Section.
- D. Testing requiring an Approved Independent Testing Laboratory shall be executed by a laboratory technician that is certified in the test being taken. At no time shall an uncertified technician be allowed to sample or test any material except under direct supervision of a qualified and certified technician. NO EXCEPTIONS.
- E. NICET and ACI are recognized certification companies for Laboratory Technicians.

1.2 SELECTION AND PAYMENT

- A. The City shall select, employ, and pay for services of an Independent Testing Laboratory to perform inspection and testing identified in Part III of individual Technical Specification sections.
- B. The Contractor may employ and pay for services of an independent testing laboratory or laboratories to perform inspection and testing identified in Part II of individual Technical Specification sections.
- C. Employment of a testing laboratory by the City shall not relieve the Contractor of its obligation to perform the Work in accordance with requirements of the Contract Documents.
- D. There shall be no separate payment of items under this Section. All testing, material, labor and equipment supplied by either the Approved Independent Testing Laboratory or the Contractor is incidental to the Work.
- E. Owners of private development projects, even in the event they are installing public infrastructure, shall contract with an Independent Testing Laboratory. The Independent Testing Laboratory shall not have any affiliation with the Owners, Contractors, Engineers or Architects on the project.

1.3 LABORATORY REPORTS

- A. Testing laboratory shall provide and distribute copies of laboratory reports to the distribution list the City's Project Manager provides at the pre-construction conference.

- B. Laboratory shall notify the material supplier, the Contractor and the City's Project Manager of reports that indicate failing test results by no later than close of business on the working day following test completion and review.

14 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge requirements of the Contract.
- B. Laboratory may not approve or accept any portion of the Work.
- C. Laboratory may not assume the Contractor duties
- D. Laboratory has no authority to stop the Work.

1.5 CONTRACTOR RESPONSIBILITIES

- A. Provide safe access to the Work and to manufacturer's facilities for the City's Project Manager and for testing laboratory personnel.
- B. Provide testing laboratory with a copy of the Construction Schedule and a copy of each update to Construction Schedule.
- C. Notify the City's Project Manager and testing laboratory a minimum of twenty-four hours (24 Hrs) previous to expected time for operations requiring inspection and testing services. When the Contractor fails to make timely prior notification, do not proceed with the operations requiring inspection and testing services.
- D. Notify Design Consultant twenty-four hours (24 Hrs) in advance when Technical Specification requires presence of Design Consultant for sampling or testing.
- E. Request and monitor testing as required to provide timely results and to avoid delays to the Work. Provide samples to laboratory in sufficient time to allow required test to be performed in accordance with specified test methods before intended use of the Product.
- F. Cooperate with laboratory personnel in collecting samples on site. Provide incidental labor and facilities for safe access to the Work to be tested, to obtain and handle samples at site or at source of Products to be tested, and to facilitate tests and inspections including storage and curing of test samples.
- G. Make arrangements with laboratory through the City's Project Manager. Payment for additional testing such as:
 - 1. Re-testing required for failed tests.
 - 2. Re-testing for nonconforming work.
 - 3. Additional sampling and tests requested beyond specified requirements.
 - 4. Insufficient notification of cancellation of scheduled tests of which are not performed.

1.6 REFERENCES

A2LA – The American Association for Laboratory Accreditation.
ASTM – American Society for Testing and Materials.
TCEQ – Texas Commission on Environmental Quality.
TDSHS – Texas Department of State Health Services.
TxDOT – Texas Department of Transportation
ISO/TES – International Organization for Standards.

PART II: PRODUCTS

- 2.1 The Contractor is to supply all equipment and labor needed to complete any testing.

PART III: EXECUTION

- 3.1 The Contractor shall notify the City's Project Manager a minimum of forty-eight hours (48 Hrs) in advance of any work which shall require testing. The City's Project Manager is there to observe test and verify compliance of specifications only. The City's Project Manager shall not help or assist in any way.

- 3.2 All testing requirements stated in this Section are minimal testing requirements. At the discretion of the City's Project Manager, more testing can be authorized. Additional testing may be requested by the Contractor at no additional cost to the City and with the approval of the City's Project Manager.

3.3 CONDUCTING TESTING

- A. The City's Project Manager shall be onsite for all testing procedures for the duration of the test and observe all procedures and document the adherence to the testing procedures as stated in this Section.
- B. Conform to laboratory sampling and testing methods specified in individual Technical Specification sections to the latest issues of ASTM standards, TxDOT methods, or other recognized test standards as approved by the City's Project Manager.
- C. Requirements of this Section shall also apply to those tests for approval of materials, for mix designs, and for quality control of materials as performed by employed testing laboratories.

3.4 BACKFILL

- A. Class I, II, and III backfill and Select fill lift placement shall not exceed six inches (6 In) to eight inches (8 In) of loose material. Clumps of material larger than six inches (6 In) in any direction shall not be allowed. Dry Density and Moisture content shall be determined by ASTM D698.
 - 1. Frequency – One (1) test per lift per five hundred linear feet (500

- Lf), or fraction thereof if less than five hundred linear feet (500 Lf), of trench or between manholes, whichever is shorter. A minimum of three (3) density tests per lift per day shall be required.
2. Compaction in the ROW – Compaction shall be a minimum of ninety-five percent (95%) of dry density and moisture shall be at optimum plus or minus three percent ($\pm 3\%$).
 3. Compaction outside of the ROW – Compaction shall be a minimum of ninety percent (90%) of dry density and moisture shall be at optimum plus or minus three percent ($\pm 3\%$).
- B. Bank run sand shall be classified using ASTM D2487. Bank run sand lift placement shall not exceed twelve inches (12 In) of loose material.
1. Bank run sand shall have no more than two percent (2%) clay lumps or balls.
 2. Bank run sand shall have less than fifteen percent (15%) material passing through a No. 200 sieve as determined by ASTM D1140.
 3. Material passing No. 40 and have a Plasticity Index less than seven (7) as determined by ASTM D4318.
- C. Cement-Stabilized Sand shall be a minimum of one and one tenth (1.1) sacks of cement per one ton (1 Tn) of sand. Sand shall meet grading requirements for Fine Aggregates of ASTM C33. Cement-stabilized sand lift placement shall not exceed twelve inches (12 In) of loose material.
1. Sampling of cement-stabilized sand shall be either:
 - a. Three (3) samples taken from the truck, one (1) from each one-third (1/3) of the truck, beginning third (3rd), middle third (3rd) and last third (3rd), or;
 - b. One (1) sample shall be taken per one hundred fifty tons (150 Tn) or one (1 pD) production day, whichever is less.
 2. Mold four (4) specimens, per sample taken, in accordance with ASTM D558, Method A.
 3. Compaction shall be a minimum of ninety-five percent (95%) and moisture shall be at optimum plus or minus three percent ($\pm 3\%$), as determined by ASTM D558.
 4. Compressive strength of cement-stabilized sand shall be tested in accordance with ASTM D1163.
 - a. Two (2) specimens shall be tested at forty-eight hours (48 Hrs) plus or minus two hours (± 2 Hrs). Compressive strength shall be average of both specimens and shall be no less than one hundred pounds per square inch (100 psi), with no one (1) specimen compressive strength below seventy pounds per square inch (70 psi).
 - b. Two (2) specimens shall be tested at seven days (7 D) plus or minus four hours (± 4 Hrs). Compressive strength shall be average of both specimens and shall be equal

to or greater than one hundred pounds per square inch (100 psi), with no one (1) specimen compressive strength below one hundred pounds per square inch (100 psi).

3.5 CONCRETE

A. Concrete mix design.

1. Each Type of Concrete shall have one (1) mix design and shall be submitted so that the City's Project Manager can send to the Independent Testing Laboratory for review a minimum of seven days (7 D) before start of concrete placement. Concrete mix designs shall conform with requirements of ASTM C94.
2. Concrete Classification shall conform to TABLE 4.1 CONCRETE CLASSIFICATION MINIMUM SPECIFICATIONS in this Section. Coarse aggregate shall conform with ASTM C33 and as specified in TABLE 4.2 COARSE AGGREGATE GRADATION in this Section.
3. Fine aggregate shall conform with ASTM C33 and as specified in TABLE 4.3 FINE AGGREGATE GRADATION in this Section.
4. Mineral filler shall only be added with the approval of the Director of Community Development and shall not exceed fifteen percent (15%) of the fine aggregate weight and conforms to TABLE 4.4 MINERAL FILLERS in this Section.
5. Admixtures shall conform to the following:
 - a. Water reducers shall conform to ASTM C494, type A.
 - b. Water reducing retarders shall conform to ASTM C494, type D.
 - c. High range water reducers (superplasticizers) shall conform to ASTM C494, Types F and G.
6. Water shall be potable.
7. Air entrainment shall be in accordance with ASTM C260 and shall be four percent (4%) plus or minus one percent ($\pm 1\%$).

B. Form Inspection.

1. Concrete Form inspection – the City's Project Manager shall inspect the forms for uniformity and bracing.
2. All forms shall be cleaned free of all dried concrete, mud or any other deleterious material.
3. Non-petroleum based form oil may be used to coat the forms that will be in contact with concrete.
4. Wood forms shall be properly seasoned, of good quality and free of imperfections that may affect its strength or impair the finished surface of the concrete.

C. Reinforcing Bar Inspection.

1. The City's Project Manager shall inspect all reinforcing bar for conformity to CFTS Section 03200 – Reinforcing Steel.
2. Reinforcing bars shall be placed according to the Drawings, the

- City of Friendswood Standard Details and the City of Friendswood Technical Specifications.
3. The minimum size of reinforcing bar shall be #4 [one-half inch (1/2 In)] and the minimum spacing shall be sixteen inches (16 In) on center unless otherwise approved by the City's Project Manager.
 4. Reinforcing bars shall be one hundred percent (100%) tied at all ends, and fifty percent (50%) tied for the interior of the mat.
 5. Splices shall have a minimum of twenty-four inches (24 In) overlapping.
 6. Chairs are to be installed so that rebar is no closer from the top than one-third (1/3) of the depth of concrete being placed.
 7. Chairs shall be placed at every other bar and under the lowest rebar for support and placed in a checkerboard pattern.
- D. Placement of Concrete.
1. Independent Testing Laboratory shall be on site at all times. The City's Project Manager shall be on site as long as deemed necessary.
 2. Placement of concrete shall not be allowed when ambient temperature is below forty degrees Fahrenheit (40° F) or above ninety-five degrees Fahrenheit (95° F) and conform to TABLE 4.5 TEMPERATURE REQUIREMENTS FOR PLACEMENT in this Section.
 3. Materials shall not exceed eight percent (8%) moisture at the plant.
 4. Travel time from batch time at plant to dispersal shall not exceed ninety minutes (90 Min) and conforming to TABLE 4.6 TRANSPORTING TIME REQUIREMENTS.
 5. Time between trucks, end of last truck placement to beginning of next truck placement shall not exceed sixty minutes (60 Min); otherwise a construction joint shall be installed.
 6. Verify the mix design for each truck is the mix design being used.
 7. Verify tare weight to actual weights.
 - a. Actual weights shall be within plus or minus one percent ($\pm 1\%$) of the tare weight.
 - b. Admixtures shall be within plus or minus one gallon (± 1 Gal) of tare.
 8. Water tank on truck shall be full when arriving on site and shall have a readable and accurate measuring gauge attached to the tank.
 9. Minimum drum rotations shall be between fifty (50) and seventy (70) before and during transport.
 10. Minimum drum rotation shall be between seventy (70) and one hundred (100) arriving at the site and before discharge of concrete.
 11. Slump shall be from three inches (3 In) to five inches (5 In) unless

- plasticizers are introduced to concrete and otherwise approved by the City's Project Manager.
12. Concrete temperature shall not drop below fifty degrees Fahrenheit (50° F) or rise above ninety degrees Fahrenheit (90° F). If ice is added to the mixture as part of the water content, then concrete temperature shall be allowed to rise above ninety degrees Fahrenheit (90° F) but no higher than ninety-five (95) degrees F as conforming to TABLE 4.5 TEMPERATURE REQUIREMENTS FOR PLACEMENT and ASTM C1064.
 13. Slump tests shall be taken in conformance with ASTM C143 at every fifty cubic yards (50 Cy) of concrete. When ambient temperature is above ninety degrees Fahrenheit (90° F), then slump tests shall be taken on every thirty cubic yards (30 Cy) of concrete.
 14. Air entrainment above five percent (5%) and below seven percent (7%), as tested in conformance with ASTM C173 or ASTM C231, may be approved for placement at the discretion of the City's Project Manager, and only accepted after the concrete has passed the twenty-eight day (28 D) compressive strength requirements.
 15. Concrete that has air entrainment lower than two percent (2%) or higher than seven percent (7%), as tested in conformance with ASTM C173 or ASTM C231 shall be rejected and shall be remove concrete from site.
 16. One (1) set of four (4) concrete cylinders in conformance with ASTM C31 for compressive strength test shall be made for every one hundred cubic yards (100 Cy) or portion there of placed in the day. Concrete placements less than one hundred cubic yards (100 Cy) in a day shall be tested at the discretion of the City's Project Manager.
 17. Two (2) cylinders shall be tested in conformance of ASTM C39 at the age of seven days (7 D). The average of the two (2) tests shall be a minimum of seventy percent (70%) of designed twenty-eight day (28 D) strength.
 18. Two (2) cylinders shall be tested in conformance of ASTM C39 at the age of twenty-eight days (28 D). The average of the two (2) tests shall equal or exceed the design strength.
 19. No more that two gallons of water per cubic yard (2 Gal/Cy) shall be introduced into the truck at the job site. After addition of any water at the site, the truck drum shall make twenty-five (25) revolutions before placement can commence.
 20. Water added after sampling for testing shall void air entrainment, slump and compressive strength tests that may have been completed before the addition of water. New sample of concrete shall be taken and testing started over again. NO EXCEPTIONS. If after warning the Contractor the condition

continues to happen, and the practice continues, the Contractor shall be charged for failed tests.

21. The City's Project Manager and the Independent Testing Laboratory Technicians have the authority to reject any concrete load not matching the City of Friendswood Technical Specifications.
22. Load tickets shall be marked rejected, state reason, along with date and time and be signed by the City's Project Manager or Independent Testing Laboratory Technician.

3.6 DETENTION POND

- A. Inspect for erosion around inflow/outflow areas and banks.
- B. Area surrounding all drainage ditches, retention and detention ponds shall have turf established at a minimum cover of ninety percent (90%) as required by CFTS Section 02900 – Turf Establishment.
- C. The drainage areas shall have either Galveston County Consolidated Drainage District (GCCDD) or Harris County Flood Control (HCFC) approval before requesting the City's Project Manager for inspection and approval. These inspection may be done simultaneously.

3.7 SANITARY SEWER MANHOLES

- A. Verify that all debris and water is removed from the interior of the manhole being tested and any grout has dried for a minimum of twenty-four hours (24 Hrs).
- B. Insert plugs in influent and effluent pipes. Plugs are to be installed a minimum of six inches (6 In) past the exterior wall of the manhole being tested.
- C. Inflate plugs to manufacturer's recommended air pressure.
- D. Inspect testing head. Verify that a gauge exists on the head and that all openings through the head are open, not sealed, with check ball valves.
- E. Install Vacuum testing head on ring of manhole. Testing head shall have a readable gauge that measures inches of mercury by inches.
- F. Begin evacuation of air from manhole. Turn pump off when the gauge reads ten inches of mercury (10 InHg).
- G. Softly tap gauge to ensure the gauge is not stuck.
- H. Hold vacuum for minimal time as required in TABLE 4.7 VACUUM TESTING TIME TABLE in this Section.
- I. After minimal time is complete, tap gauge twice. If the loss of mercury is one inch (1 In) or less the manhole is considered to have passed.

3.8 SANITARY SEWER FORCE MAINS

- A. Testing for High Density Polyethylene (HDPE) Pipe shall be in accordance with paragraph 3.11 of this Section.
- B. Hydrostatic Testing.
 1. Plug both ends of pipe to be tested.
 2. Provide a gauge with a range from zero pounds per square inch

- (0 psi) to three hundred pounds per square inch (300 psi), graduated in five pounds per square inch (5 psi) increments and is a minimum of three inches (3 In) in diameter. Provide a water tank and a water meter.
3. Fill pipe with water and pressure to either one hundred fifty (150 psi) or one and one-half (1.5) times the design pressure, whichever is greater.
 4. Hold pressure for minimum of four hours (4 Hrs).
 5. If pressure has held for four hours (4 Hrs), the pipe has passed.
 6. If pressure has lost pressure, calculate the maximum allowed loss of water using the following formula.

$$4L = \frac{(S)(D)(P_{0.5})}{133,200}$$

7. Pressure pipe back up to one hundred fifty (150 psi), and record number of gallons required to achieve pressure. If less than or equal to 4L, then pipe is considered to have passed.
- C. Pigging Test
1. Pigging test shall be conducted on force mains longer than two hundred feet (200 Ft).
 2. Pig shall be open-cell polyurethane with no abrasives or coatings.
 3. Pigs shall be capable of passing through reductions of up to sixty-five percent (65%) of nominal cross-section of pipe being tested.
 4. Pigs shall be capable of passing through all standard fittings.
 5. If pig passes through line being tested, the line is clear of obstructions and is considered to have passed.

3.9 SANITARY SEWER GRAVITY LINES

A. Low Pressure Air Test.

1. Low pressure air test shall conform to ASTM C828, ASTM C924 or ASTM F1417.
2. Clean both ends of pipe free of debris and water.
3. Install and inflate testing balls to manufacturer's recommended air pressure.
4. Pressure gravity sanitary sewer line to five pounds per square inch (5 psi) and hold for the minimum time as specified in TABLE 4.9 TIME ALLOWED FOR PRESSURE LOSS FROM 5.0 PSI TO 4.0 PSI in this Section.
5. For lengths longer than the minimum time multiply additional length by factor as specified in CFTS Section 02525 – Table 4.2 TIME ALLOWED FOR PRESSURE LOSS FROM 5.0 PSI TO 4.0 PSI.

6. If test pressure drops below four pounds per square inch (4 psi) before the minimal testing time has been achieved then the test is considered to have failed. The Contractor shall make repairs as necessary and schedule a retest.
- B. TV INSPECTION
 1. One week (1 Wk) prior to mandrel test, sewer lines shall be cleaned and a TV inspection completed on each line, from upstream to downstream end.
- C. MANDREL TEST
 1. Mandrel testing shall conform to ASTM D3034.
 2. No mandrel test shall be performed until after the gravity sanitary sewer has been installed for a minimum of thirty days (30 D).
 3. Install mandrel pull string from manhole to manhole. Pull string shall not exceed three-eighths inch (3/8 In) thick nylon rope for pulling the mandrel.
 4. Inspect mandrel size using proving ring provided. Proving ring shall fit snug over the mandrel. Verify that the mandrel is the correct size for the pipe being tested.
 5. Once the mandrel is placed in the upstream pipe, slowly pull mandrel to the next manhole. Mandrel shall be pulled in the manhole by one (1) person. Mechanical equipment shall not be allowed to pull the mandrel through the pipe.
 6. When mandrel reaches next manhole, mandrel shall be lifted and shown to the City's Project Manager. Mandrel shall never be pulled straight through a manhole, no exceptions.
 7. If mandrel gets stuck in the pipe being tested, remove the mandrel and correct defects to the pipe and retest.
- D. SMOKE TEST
 1. Smoke test shall only be used on existing sanitary sewers that have been repaired or rehabilitated.
 2. Only test from one (1) manhole to one (1) manhole section at a time.
 3. Residents shall be notified no fewer than two days (2 D) and no more than seven days (7 D) before smoke testing is scheduled to take place.
 4. Public Works, Police Department, Fire Department and Notification Contacts shall be notified twenty-four hours (24 Hrs) prior to actual smoke testing.
 5. Isolate section gravity sanitary sewer line to be tested at each manhole.
 6. Introduce smoke into one (1) or both manholes. Operate smoke generator for a minimum of five minutes (5 Min).
 7. Inspect all service line connections at the gravity sanitary sewer main for leaks. Repair and retest all leaks.
 8. Visually inspect each house on the line being tested. Look for smoke coming through the plumbing vent stack on each house.

9. Any house that does not have smoke coming through the plumbing vent stack shall be checked for proper connection to the gravity sanitary sewer line being tested. Method of checking for proper connection shall be to introduce dye into the service line system at a point on landowner's property, and visually watch for dye to exit into downstream manhole. If no dye is seen, repair and retest service connection.

3.10 SUBGRADE

A. Lime Determination and Atterberg Limits

1. Have Independent Testing Laboratory obtain a representative sample of material.
2. Conform to ASTM D4318 to determine Liquid Limit, Plastic Limit and Plasticity Index.
3. Conform to ASTM D698 for Lime Determination. Minimum Lime content shall be no less than six percent (6%).
4. Make Lime Determination for soil to bring soil to a PI of no more than fifteen (15).

B. Lime Solids Test

1. Lime Solids test shall conform to TxDOT Tex-600-J.
2. Take sample from back of distributor truck.
3. Weigh and calculate samples for Dry Solids as specified in TxDOT Tex-600-J.

C. Gradation Test

1. Immediately after the re-mix of the lime-stabilized subgrade and before lime-stabilized subgrade is compacted, conform to TxDOT Tex-101-E, Part III dry method requirements for testing subgrade using sieve analysis.
2. Three (3) random samples shall be taken and tested for every six hundred linear foot (600 Lf) of roadway section or portion thereof for day's production.
3. Locations of the sample areas shall be determined by the City's Project Manager and shall vary from left, center and middle of roadway being tested.
4. Samples shall be a representative sampling of the lime-stabilized subgrade.
5. All three (3) samples must pass sieve analysis. If any one sample fails then the Contractor shall rework the roadway section tested and have it retested at no cost to the City.
6. Immediately after the roadway section has passed the sieve analysis, the Contractor shall commence to compaction of subgrade.

D. Compaction

1. Notify the City's Project Manager a minimum of forty-eight hours (48 Hrs) before testing for compaction.
2. The City's Project Manager shall identify the locations for all

- density testing.
- 3. Compaction shall be a minimum of ninety-five (95%) of dry density and moisture shall be at optimum plus or minus three percent ($\pm 3\%$).
- 4. There shall be only two (2) tests performed in any one (1) hole at one (1) time to achieve density readings. Moving the Nuclear Density Gauge around more that this shall fail the whole work area being tested.
- 5. Three (3) density tests per lane shall be performed on every two hundred linear feet (200 Lf) of roadway.
- 6. After one inch (1 In) or more of documented rainfall, subgrade shall be retested and shall conform to 3.9.D.3 and 3.9.D.4.
- 7. After one inch (1 In) or more of rain, every five hundred feet (500 Ft) per lane of roadway shall be tested.
- 8. Stipulations in 3.9.D.6 and 3.9.D.7 shall be reinstituted after each additional one inch (1 In) of rainfall until paving has been placed.
- E. In-place Depth Test
 - 1. Contractor shall notify the City's Project Manager a minimum of forty-eight hours (48 Hrs) prior to the start of testing.
 - 2. In place depth test for lime-stabilization shall conform to TxDOT Tex-140-E.
 - 3. Tests shall be taken in hand excavated holes only. NO EXCEPTIONS.
 - 4. Three (3) samples shall be taken for each one thousand foot (1000 Ft) section of subgrade place per lane.
 - 5. Depth shall be based on the average of all three (3) samples from the section being tested.
 - 6. Failing sections shall be remixed and recompactd with correct amount of subgrade in place.

3.11 WATER LINES

- A. Bacteriological Test (BAC-T)
 - 1. The Contractor shall notify the City's Project Manager at least forty-eight hours (48 Hrs) in advance of testing. All testing shall conform to TCEQ and TDSHS. NO EXCEPTIONS.
 - 2. The City's testing collection times shall be at 10:00 a.m. on Tuesdays and Thursdays only. NO EXCEPTIONS.
 - 3. Water line shall have been thoroughly flushed prior to and at least on the day of the scheduled testing.
 - 4. The City's Public Works Department personnel shall open the valves and collect the samples.
 - 5. There shall be one (1) BAC-T taking for every one thousand linear feet (1000 Lf) of pipe installed. Any linear footage, no matter the amount, over one thousand linear feet (1000 Lf) shall require another BAC-T for that portion.
 - 6. The City's Project Manager shall identify and mark the locations

- of the BAC-T's to be taken.
7. Maximum testing length shall be no more than four thousand linear feet (4000 Lf) at one (1) given testing day.
 8. Optimum chlorine content for testing shall be from **two-tenths parts per million (0.2 ppm) free chlorine or five-tenths parts per million (0.5 ppm) total chlorine** and no more than **three and nine-tenths parts per million (3.9 ppm) free or total chlorine**. Water lines having chlorine **levels greater than three and nine-tenths parts per million (3.9 ppm) free or total chlorine** shall not be tested and shall be flushed until the chlorine is in the acceptable range.
 9. If the water lines have not been isolated for testing purposes, then all tests taken shall come back negative. One (1) positive test on non-isolated lines is a failure of the whole line being tested and BAC-T's for the entire line shall be retaken.
 10. After two (2) failed BAC-T's the Contractor shall re-chlorinate and flush the failing water line.
 11. The Contractor may, upon the approval of the City's Project Manager, take samples and use an alternate lab provided that the following conditions are met:
 - a. Project Manger shall be present at all times during the testing process.
 - b. The alternate lab shall be qualified and recognized under TCEQ and TDSHS rules and regulations.
 - c. Laboratory shall send a representative of their company to pick up samples. The Contractor shall not transport the samples to the laboratory. Chain of custody shall be maintained by the laboratory's personnel.
 - d. Copies of all reports shall be sent immediately from the lab to the City's Project Manager.
- B. Testing for High Density Polyethylene (HDPE) Pipe shall be in accordance with paragraph 3.11 of this Section.
- C. Hydrostatic Test of Water Lines
1. The Contractor shall notify the Project Manger a minimum of forty-eight hours (48 Hrs) before testing.
 2. Hydrostatic Testing shall conform to American Water Works Associations' Manual M-23, latest revision.
 3. The Contractor shall supply all pumps, gauges, meters and other equipment necessary to perform the test procedures. Testing gauge shall measure pressure in five pounds per square inch (5 psi) increments.
 4. One (1) test shall be taken for every one thousand linear feet (1000 Lf) of water line.
 5. Fill the auxiliary tank full of water and using the pressure pump, pressurize the water line to one hundred fifty pounds per square inch (150 psi). [Dedicated Fire Lines shall be pressurized to two

- hundred pounds per square inch (200 psi)].
6. After gauge achieves one hundred pounds per square inch (150 psi), close valves and stop pump.
 7. Softly tap the glass of the gauge. Start time of the test.
 8. Test time shall be no less than a minimum of four hours (4 Hrs). [Dedicated Fire Lines shall be tested for no less than a minimum of two hours (2 Hrs)].
 9. At the end of the test period, softly tap pressure gauge, if needle does not move then the line is considered to have passed.
 10. Fill line back up with water and use the following water to calculate minimum allowed loss as calculated using the formula below:
$$L = \frac{4NDP^{1/2}}{7400}$$
 11. If amount of gallons lost is less than that calculated, then the test is considered to have passed.

3.12 Hydrostatic Testing of High Density Polyethylene (HDPE) Pipe in Pressurized Systems.

A. Restraint.

1. All valves, tees elbows and dresser couplings shall be restrained with stainless steel all thread.
2. Test gauge shall be installed at the lowest point in the test section.

B. Pipe filling:

1. Quantity of liquid needed to fill the internal volume of the pipe test section shall be estimated using the following formula:

$$V_{GAL} = 0.04 \times ID_{IN}^2 \times L_{FT}$$

where:

- a. V_{GAL} = pipe section volume in U.S. gallons
 - b. ID_{IN} = pipe inside diameter in inches
 - c. L_{FT} = test section length in feet
2. An appropriate excess quantity of liquid, up to forty percent (40%), may be needed to account for pipe expansion and possibility of leakage.
 3. Fill test section of pipe slowly, allowing all air to be purged from the pipe.
 4. Allow the test section and the test liquid to equalize in temperature.

C. Initial Expansion Phase.

1. Expansion Phase can take up to, but shall be no longer than, four hours (4 H).
2. Slowly pressurize the test section to test pressure, one hundred-fifty pounds per square inch (150 PSI), and maintain for three hours (3 H). During the initial expansion phase the polyethylene pipe will expand slightly. Additional test liquid will be required to

- maintain test pressure.
- D. Testing Phase
1. Immediately following the initial expansion phase, monitor the amount of liquid required to maintain test pressure (150 psi) for one hour (1 H).
 2. If the amount of liquid does not exceed the amount listed in TABLE 4.10 MAKE-UP WATER ALLOWANCE, then no leakage is detected and the test section a passing test is indicated.
 3. Should the test fail and retesting become necessary, depressurize test section in accordance with paragraph 3.11.E.
 - a. Do not attempt to correct faults or leaks until after test section is completely depressurized.
 - b. A minimum relaxation period of eight hours (8 H) shall be observed before re-pressurization. After relaxation period, retest starting with the initial expansion phase.
- E. Post Test Procedures.
1. At the conclusion of the test, test section shall be depressurized by a controlled release of the test fluid. The potential of a pressure surge is avoided by a controlled release.

PART IV: TABLES

4.1 CONCRETE CLASSIFICATION MINIMUM SPECIFICATIONS

CONCRETE CLASSIFICATION MINIMUM SPECIFICATIONS					
<i>Class of Concrete</i>	<i>Sacks of Cement per Cubic Yard Minimum</i>	<i>Minimum Compressive Strength at 28 Days</i>	<i>Maximum Cement to Water Ratio</i>	<i>Coarse Aggregate Grade Number</i>	<i>Slump</i>
<i>A</i>	<i>5.0</i>	<i>3000</i>	<i>6.25</i>	<i>2 – 3</i>	<i>3 – 5*</i>
<i>B</i>	<i>6.0</i>	<i>3600</i>	<i>6.00</i>	<i>1,2,3,4,5</i>	<i>4</i>
<i>C</i>	<i>4.0</i>	<i>2000</i>	<i>8.00</i>	<i>2,3,4,5,6,7</i>	<i>5</i>
<i>D</i>	<i>6.0</i>	<i>3000</i>	<i>6.00</i>	<i>2,3,4,5</i>	<i>5</i>
<i>E</i>	<i>6.0</i>	<i>As specified</i>	<i>5.50</i>	<i>3,4,5,6</i>	<i>5</i>
<i>F</i>	<i>8.75</i>	<i>5500</i>	<i>3.6</i>	<i>6</i>	<i>5</i>

****When ASTM C494, Type F or Type G admixture is used to increase workability, this range may be 6 to 9.***

4.2 COARSE AGGREGATE GRADATION

COARSE AGGREGATE GRADATION CHART										
Aggregate Grade No.	Nomina l Size Inches	Percent Retained on Each Sieve								
		2-1/2 In.	2 In.	1-1/2 In.	1 In.	3/4 In.	1/2 In.	3/8 In.	No. 4	No. 8
1	2	0	0-20	15- 50		60- 80			95- 100	
2 (467)*	1-1/2		0	0-5		30- 65		70- 90	95- 100	
3	1-1/2		0	0-5		10- 40	40- 75		95- 100	
4 (57)*	1			0	0-5		40- 75		90- 100	95- 100
5 (67)*	3/4				0	0-10		45- 80	90- 100	95- 100
6 (7)*	1/2					0	0-10	30- 60	85- 100	95- 100
7	3/8						0	5-30	75- 100	
8	3/8						0	0-5	35- 80	90- 100

*** Numbers in parenthesis indicate that the gradations conform to Corresponding ASTM gradation in ASTM C33.**

4.3 FINE AGGREGATE GRADATION

FINE AGGREGATE GRADATION CHART								
Aggregate Grade No.	Percent Retained on Each Sieve							
	3/8 In.	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
1	0	0-5	0-20	15- 50	35- 75	65- 90	90-100	97-100

4.4 MINERAL FILLERS

MINERAL FILLER GRADATION CHART		
Percent Retained on Each Sieve		
No. 20	No. 30	No. 100
0 %	0 to 5 %	0 to 30 %

4.5 TEMPERATURE REQUIREMENTS FOR PLACEMENT

PLACEMENT TEMPERATURE REQUIREMENTS	
AMBIENT TEMPERATURE¹	
Minimum temperature to start placing concrete	35° and rising
Minimum temperature to stop placing concrete	40° and falling
Maximum temperature for placing concrete without ice	90°
Maximum temperature for placing concrete with ice	100°
CONCRETE TEMPERATURE	
Minimum concrete temperature	50°
Maximum concrete temperature without ice	90°
Maximum concrete temperature with ice	95°
MINIMUM CURING TIMES WHEN PLACED CONCRETE HAS BEEN EXPOSED TO FREEZING TEMPERATURES	
From 50° to 70°, minimum days	5
70° and above, minimum days	3
¹ Ambient temperature is to be taken as specified in paragraph 3.3.F.1 of this section.	

4.6 TRANSPORTING TIME REQUIREMENTS

TRANSPORTING TIME REQUIREMENTS FOR PLACEMENT		
Ambient Temperature	Maximum Time (No Retarding Agent) in Minutes	Maximum Time (With Retarding Agent) in Minutes ¹
Non-Agitated Concrete		
Above 80° F	15	30
80° F and Below	30	45
Agitated Concrete		
Above 90° F	45	75
75° F to 90° F	60	90
75° F and Below	90	120
NOTE: Time interval shall be from the addition of cement to the batch to start of placement of concrete in the forms. ¹ Normal Dosage of retarder.		

4.7 TIME ALLOWED FOR PRESSURE LOSS FROM 5.0 PSI TO 4.0 PSI

Pipe Dia. In.	Min. Time mm:ss	Length for Min. Time	Time for Longer Length	Specification Time for Length (L) shown in MM:SS				
				100'	150'	200'	250'	300'
6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52
12	11:20	199	3.4190	11:20	11:20	11:20	14:15	17:06
15	14:10	159	5.3423	14:10	14:10	17:48	22:16	26:43
18	17:00	133	7.6928	17:00	19:14	25:39	32:03	38:28
21	19:50	114	10.4708	19:50	26:11	34:54	43:38	52:21
24	22:40	99	13.6762	22:48	34:11	45:35	56:59	68:23
27	25:30	88	17.3089	28:51	43:16	57:42	72:07	86:33
30	28:20	80	21.3690	35:37	53:25	71:14	89:02	106:51
33	31:10	72	25.8565	43:06	64:38	86:11	107:44	129:17

Pipe Dia. In.	Min. Time mm:ss	Length for Min. Time	Time for Longer Length	Specification Time for Length (L) shown in MM:SS					
				350'	400'	450'	500'	550'	600'
6	5:40	398	0.8548	5:40	5:42	6:25	7:07	7:50	8:33
8	7:33	298	1.5196	8:52	10:08	11:24	12:08	13:56	15:12
10	9:27	239	2.3743	13:51	15:50	17:48	19:47	21:46	23:45
12	11:20	199	3.4190	19:57	22:48	25:39	28:30	31:20	34:11
15	14:10	159	5.3423	31:10	35:37	40:04	44:31	48:58	53:25
18	17:00	133	7.6928	44:52	51:17	57:42	64:06	70:31	76:56
21	19:50	114	10.4708	61:05	69:48	78:32	87:15	95:59	104:42
24	22:40	99	13.6762	79:47	91:10	102:34	113:58	125:22	136:46
27	25:30	88	17.3089	100:58	115:24	129:49	144:14	158:40	173:05
30	28:20	80	21.3690	124:39	142:28	160:16	178:05	195:53	213:41
33	31:10	72	25.8565	150:50	172:23	193:55	215:28	237:01	258:34

4.8 – VACUUM TESTING TIME TABLE

TIME ALLOWED FOR VACUUM LOSS FROM 10.0 Hg TO 9.0 Hg			
	TIME IN SECONDS BY DIAMETER OF MANHOLES		
Manhole Depth in Feet	48" Diameter	60" Diameter	72" Diameter
8' and less	14	18	23
10	17	23	28
12	21	28	34
14	25	32	40
16	28	37	45
18	23	41	51
20	35	46	57
22	39	51	62
24	42	55	68
26	46	60	74
28	49	64	80
30	53	69	85

4.9 MINIMUM TESTING TIMES FOR LOW PRESSURE AIR TEST

Pipe Diameter (Inches)	Minimum Time (seconds)	Length of Pipe for Minimum Time (feet)	Time for Longer Length (seconds)
6	340	398	0.855 (L)
8	454	298	1.520 (L)
10	567	239	2.374 (L)
12	680	199	3.419 (L)
15	850	159	5.342 (L)
18	1020	133	7.693 (L)
21	1190	114	10.471 (L)
24	1360	99	13.676 (L)
27	1530	88	17.309 (L)
30	1700	80	21.369 (L)
33	1870	72	258.856 (L)

4.10 MAKE-UP WATER ALLOWANCE

Nominal Pipe Size (Inches)	Allowable Gallons per 100 Feet of Pipe	Nominal Pipe Size (Inches)	Allowable Gallons per 100 Feet of Pipe
1-1/4	0.06	12	1.1
1-1/2	0.07	14	1.4
2	0.07	16	1.7
3	0.10	18	2.0
4	0.13	20	2.8
5	0.21	22	3.5
6	0.3	24	4.5
8	0.5	26	5.0
10	0.8	28	5.5

END OF SECTION

UTILITY DIVISION VALVE ASSISTANCE PROCEDURES

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A The City of Friendswood employees shall operate all existing valves. The Contractor's employees may operate new valves included in the Work prior to acceptance by the City. **Under no circumstances shall The Contractor be permitted to operate existing valves.**

1.2 PROCEDURE

- A Perform activities listed in this Section. Utility Division personnel shall also follow these procedures when completing a request, Document 01095 – Utility Division Valve Assistance Request Form, from individual Contractors, through Project Manager, for operation of existing water valves.

1.3 CANCELLATION

- A The Contractor, the Project Manager, or Utilities Division may cancel a scheduled valve assistance appointment at no extra cost or payment to the Contractor. The Contractor shall notify the Project Manager a minimum of twenty-four hours (24 Hrs) in advance of scheduled valve operation. The Project Manager shall notify the Department of Public Works immediately upon receipt of cancellation notice. Cancellation may be caused by bad weather, preparation work taking longer than anticipated or unforeseen delays by one (1) or more of the three (3) parties.

PART II: PRODUCTS – NOT USED.

PART III: EXECUTION

3.1 ROUTINE VALVE ASSISTANCE REQUEST

- A When notified by the Contractor, the Project Manager shall schedule a work order planning meeting by sending Document 01125 – Utility Division Valve Assistance Request Form to the Department of Public Works and providing information shown below. The work order planning meeting shall be conducted a minimum of three days (3 D) prior to the date requested for valve operations; excluding weekends, holidays, inclement weather days, and the day of the call. The Contractor will provide a map using the City's GIS public portal or sheets from the Civil Utility Drawings as part of the request. The Utility Division will coordinate with The Contractor and Project Manager to identify valves and potential customers to be impacted by the valve operation request.

The Utility Division shall not be held responsible for notification to said customers or for customers impacted in addition to the service area identified. The Contractor shall reference 01030 Work Restrictions for notification requirements.

1. Project Name.
 2. Project Number.
 3. Location of the Work requested.
 4. Date and time assistance requested.
 5. Contractor's Name.
 6. Superintendent's Name.
 7. Superintendent's Phone Number.
 8. Project Manager's Name.
 9. Project Manager's Phone Number.
- B. The Department of Public Works shall create a work order for each wet connection, cut and plug, etc.
- C. The Department of Public Works shall give the Project Manager the work order number. This work order number must be used as a reference in all communications regarding this request for Valve Assistance.
- D. When Utility Division personnel arrive at the job site for the Work Order Planning Meeting between the Project Manager, the Contractor, and Utility Division personnel, they will verify the street intersection and work order number with the Project Manager before beginning Work Order Planning Meeting.
- E. During Work Order Planning Meeting, the work to be performed will be outlined and the actual date the work shall be performed will be mutually determined by the Project Manager, the Contractor and City's Utility Division personnel, based upon relevant factors such as preparatory work needed, customer requirements, etc.
- F. Utility Division personnel shall perform work specifically outlined in the work order requested. Also, Utility Division personnel shall operate only existing water valves. The Project Manager shall contact the Department of Public Works and request a new work order for additional work.
- G. Utility Division personnel will contact the Public Works and advise when the job is complete. Utility Division personnel will list all appropriate information on the Work Order.
- H. Should Utility Division personnel not be able to keep an appointment to provide valve assistance, Utility Division shall provide notification to appropriate Project Manager by phone at least twenty-four hours prior (24 Hrs), with that fact and rescheduling information, if available.
- I. The Project Manager shall notify the Department of Public Works if Utility Division personnel have not arrived at the site within thirty minutes (30 Min) of scheduled appointment. If the Contractor is not ready when Utility Division personnel arrives to provide valve assistance, the City shall charge the Contractor sixty-five dollars (\$65.00) per hour, per employee, starting thirty minutes (30 Min) after the scheduled appointment time, minimum one hour (1 Hr) charge.

- J. The Contractor shall not be due delay claims or downtime if Utility Division has notified the Project Manager that they will not be able to provide valve assistance as scheduled.
- K. Test installed new valves in the presence of the Project Manager and the Utilities Supervisor during the substantial completion inspection. Place new valves in open position on or before the Date of Substantial Completion.
- L. The Project Manager shall notify, in writing, the Department of Public Works one month (1 Mo) before the one-year (1 Yr) maintenance bond expires to report any problems they have with new water lines. The Project Manager shall notify the Contractor about these problems.

3.2 EMERGENCY REQUEST FOR VALVE ASSISTANCE PROCEDURE

- A. When notified by the Contractor, the Project Manager shall request emergency Valve Assistance due to a broken line/service, etc. by calling the Department of Public Works at (281) 996-3380 and providing the following information:
 - 1. Project Name.
 - 2. Project Number.
 - 3. Location of the Work requested.
 - 4. Nature of the emergency.
 - 5. Contractor's Name.
 - 6. Superintendent's Name.
 - 7. Superintendent's Phone Number.
 - 8. Project Manager's Name.
 - 9. Project Manager's Phone Number.
- B. The Department of Public Works shall create an emergency work order number and describe the work to be performed.
- C. The Department of Public Works shall give the Project Manager the emergency work order number. Reference work order number in all communications regarding request for Valve Assistance.
- D. The Department of Public Works shall contact Utility Division personnel and assign the emergency work order.
- E. When Utility Division personnel arrive at the job site for emergency work, they shall verify the street intersection and emergency work order number with the Project Manager prior to beginning the work requested for operating existing water valves. Utility Division personnel shall coordinate verification of street intersection and work order number with the Project Manager prior to performing work.

3.3 AFTER HOURS EMERGENCY VALVE ASSISTANCE

- A. If, after normal working hours, it becomes necessary for valve assistance, the Contractor or the Project Manager shall call the Police Dispatcher at (281) 996-3300 and supply said dispatcher with the following information:
 - 1. Caller's Name.
 - 2. Caller's Title.

3. Caller's Employer.
 4. Nature of the emergency.
 5. Location of the emergency.
- B. The Dispatcher shall follow standard procedures and notify the Utility Division Person On-call and relay this information.
 - C. The Utility Division Person On-call shall notify the Project Manager of the emergency, and both shall go to the location and assess the emergency.
 - D. The Utility Division Person On-call shall determine if other personnel are needed, and procedure to call them in as needed. The Utility Division Person On-call shall document all activities, equipment, personnel and time used, and will send it to the Department of Public Works the following regular business day.

END OF DOCUMENT

UTILITY DIVISION
VALVE ASSISTANCE REQUEST FORM

DATE REQUESTED: {INSERT DATE}

TIME REQUESTED: {INSERT TIME}

Type of Assistance Required:

☐ Valve Operation

☐ Water and Sewer Utilities locate

☐ Bacterial Testing (BAC-T)

☐ Flushing Waterlines

Project Name: Lift Station No. 2 Rehabilitation

Project Number: {INSERT PROJECT #}

Company Requesting Assistance: {INSERT CONTRACTOR NAME}

Company Contact Name: {INSERT CONTRACTOR CONTACT}

Company Telephone: {INSERT CONTACT PHONE #}

Company Fax: {INSERT CONTRACTOR FAX}

Type of Work: {INSERT CONTRACTOR WORK TYPE}

Location of Work: {INSERT ASSISTANCE LOCATION}

Nearest Cross Street: {INSERT NEAREST CROSS STREET}

Project Manager: {INSERT PROJECT MANAGER}

Project Manager Phone Number: {INSERT PM PHONE #}

DEPARTMENT OF PUBLIC WORKS USE ONLY

Received By: _____

Date Received: _____ Time Received: _____

END OF DOCUMENT

SYSTEM STARTUPS AND OPERATION AND MAINTENANCE MANUALS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Submittal requirements for equipment and facility Operations and Maintenance (O&M) Manuals.
- B. System startup with demonstration and instructions.
- C. Testing, adjusting and balancing.

1.2 OPERATION AND MAINTENANCE MANUALS

- A. Furnish manufacturers' O&M Manuals for all equipment. Manuals must contain, as a minimum, the following:
 - 1. Equipment functions, normal operating characteristics, and limiting conditions.
 - 2. Assembly, Installation, alignment, adjustment, and checking instructions.
 - 3. Operating instructions for start-up, normal operation, regulation and control, normal shutdown, and emergency shutdown.
 - 4. Detailed drawings showing the location of each maintainable part and lubrication point with detailed instructions on disassembly and reassembly of the equipment.
 - 5. Troubleshooting guide.
 - 6. Spare parts list, predicted life of parts subject to wear, lists of spare parts recommended to be on hand for both initial start-up and for normal operating inventory, and local or nearest source of spare parts availability.
 - 7. Outline, cross-section, and assembly drawings with engineering data and wiring diagrams.
 - 8. Test data and performance curves.
- B. Furnish parts manuals for all equipment, prepared by the equipment manufacturer, which contain, as a minimum, the following:
 - 1. Detailed drawings giving the location of each maintainable part.
 - 2. Spare parts list with predicted life of parts subject to wear, lists of spare parts recommended on hand for both initial start-up and for normal operating inventory and local or nearest source of spare parts availability.

PART II: PRODUCTS – Not Used.

PART III: EXECUTION

3.1 PREPARATION

- A. Coordinate schedule for start-up of various equipment and systems.

- B. Notify the Project Manager seven (7) days prior to startup of each item.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other damage-causing conditions.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision in accordance with manufacturer's instructions.
- G. When specified in individual Technical Specification sections, require manufacturer to provide an authorized representative to be present at the site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit written report indicating that equipment or system has been properly installed and is functioning correctly.

3.2 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of Products to the Project Manager two (2) weeks prior to Date of Substantial Completion.
- B. Utilize O&M Manuals as the basis for instruction. Review contents of manual with the Project Manager in detail to explain aspects of operation and maintenance.
- C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at the equipment location.
- D. Prepare and insert additional data in O&M Manuals when the need for additional data becomes apparent during instruction.
- E. At a minimum, the Contractor will demonstrate the following:
 - 1. Products and procedures to be used in maintaining various surfaces, e.g., counter tops, toilet partitions, tile floors and carpeting;
 - 2. procedures to set and maintain landscape irrigation system;
 - 3. procedures to set and maintain security and fire alarm systems; and
 - 4. procedures to set and maintain HVAC systems.

3.3 TESTING, ADJUSTING AND BALANCING

- A. The Contractor shall appoint, employ and pay for the services of an independent firm to perform testing, adjusting and balancing.
- B. Submit reports by the independent firm to the Project Manager describing observations and results of tests and signifying compliance or non-compliance with specified requirements and requirements of the Contract.

END OF SECTION

01100-2

TREE AND PLANT PROTECTION

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Tree and plant protection and maintenance.
- B. Planting new trees and relocating and replanting existing trees.
- C. Maintenance of planted or replanted trees.

1.2 PROJECT CONDITIONS

- A. Preserve and protect existing trees and plants that are to remain; from damage to foliage, branches, trunk, or roots; that could result from construction operations.
- B. Do not remove any Tree unless Parks and Recreation Department grants written permission for removal. Prevent following types of damage:
 - 1. Compaction of root zone by foot, vehicular traffic, or material storage.
 - 2. Trunk damage from equipment operations, material storage, or from nailing or bolting.
 - 3. Trunk and branch damage caused by ropes or guy wires.
 - 4. Root poisoning from spilled solvents, gasoline, paint, and other noxious materials.
 - 5. Branch damage due to improper pruning or trimming.
 - 6. Damage from lack of water due to:
 - a. Cutting or altering natural water migration patterns near root zones.
 - b. Failure to provide adequate watering.
 - 7. Damage from alteration of soil pH factor caused by depositing lime, concrete, plaster, or other base materials near roots.
 - 8. Cutting of roots larger than one and one-half inches (1-1/2 In) in diameter.

1.3 DAMAGE ASSESSMENT

- A. When a Tree, other than those permitted for removal, are destroyed or badly damaged as result of construction operations, remove and replace with same size, species, and variety. Replace trees larger than eight inches (8 In) in diameter with an eight inch (8 In) diameter tree of same species and variety.
- B. Contract Price shall be reduced by the amount determined by Parks and Recreation Department if the tree is not replaced.

1.4 REFERENCES

- A. ISA – International Society of Arboriculture.

PART II: PRODUCTS

2.1 MATERIALS

- A. Burlap: Suitable for use as tree wrapping.
- B. Fertilizer: Liquid containing twenty percent (20%) nitrogen, ten percent (10%) phosphorus and five percent (5%) potash.
- C. Obtain the Project Manager's approval of replacement trees.

PART III: EXECUTION

3.1 PROTECTION AND MAINTENANCE OF EXISTING TREES AND SHRUBS

- A. Trees within the Project area, except for trees shown on the Drawings or directed by the Project Manager to be removed and relocated, are to remain in place. Protect from damage and maintain trees that are to remain.
- B. Perform the following for trees or shrubs that are to remain:
 - 1. Trim trees and shrubs under supervision of a professional tree surgeon or horticulturist.
 - a. Prune trees according to International Society of Arboriculture specifications.
 - b. Prune trees and shrubs requiring pruning for construction operations for balance and to maintain proper form and branching habit.
 - c. Cut limbs at branch collar and remove stubs. Do not gouge outer layer of tree structure or trunk.
 - d. Prior to construction, prune all trees to remain of new or recent growth to maintain basic branching form of trees. Base extent of pruning upon proximity of pavement to trunk and size of tree blockouts and requirements of construction adjacent to tree.
 - e. Limit pruning of young branches to the maximum extent possible. Maintain older branches that provide basic form of tree. Prune in the presence of the Project Manager.
 - 2. Use extreme care to prevent excessive damage to root systems.
 - a. Cut tree roots in construction area smoothly with a trencher before excavating. Do not allow ripping of roots with backhoes or other equipment.
 - b. Temporarily cover exposed roots with wet burlap to prevent roots from drying out.
 - c. Cover exposed roots with soil as soon as possible.
 - 3. Prevent damage or compaction of root zone (area below drip line) by construction activities.
 - a. Do not allow equipment to scar trunks or limbs.
 - b. Do not store construction materials, vehicles, or excavated material under drip line of trees.

- c. Do not pour liquid materials under drip line.
- 4. Water and fertilize remaining trees and shrubs to maintain their health during construction period.
 - a. Water landscaping during construction operations at least once every seven days (7 D) in cold months and once every four days (4 D) in hotter months.
 - b. Saturate soils to at least six inches (6 In) to eight inches (8 In) beneath surface.
- 5. Water areas currently being served by private sprinkler systems while systems are temporarily taken out of service to maintain health of existing landscapes.
- 6. With the Project Manager's permission, shrubs to remain may be temporarily transplanted and returned to original positions under supervision of professional horticulturist.

3.2 PROTECTION

- A. Protection of Trees or Shrubs in Open Area:
 - 1. Install steel drive-in fence posts in protective circle, approximately eight feet (8 Ft) on center, not closer than four feet (4 Ft) to trunk of trees or stems of shrubs.
 - 2. Insert steel drive-in fence posts a minimum of three feet (3 Ft) into ground, leaving a minimum of five feet (5 Ft) above ground.
 - 3. Mount fluorescent orange construction fence on fence posts.
 - 4. For trees or shrubs in paved areas, use movable posts consisting of two one-half inch (2-1/2 In) minimum diameter concrete-filled steel pipe mounted in rubber automobile tires filled with concrete.
- B. Provide timber wrap protection for trees in close proximity to equipment when work is required within construction fencing.
 - 1. Wrap trunk with a layer of burlap.
 - 2. Install vertical five foot (5 Ft) to six foot (6 Ft) long, two inch by four inch (2 In x 4 In) or two inch by five inch (2 In x 5 In) studs, spaced three inches (3 In) to five inches (5 In) apart, around circumference of tree trunk.
 - 3. Tie burlap in place with twelve (12) gauge to nine (9) gauge steel wire.

3.3 RELOCATING AND PLANTING NEW TREES

- A. Employ a qualified Arborist, acceptable to the Project Manager, to plant and to move and relocate trees. Arborist must be normally engaged in the field and have a minimum of five years (5 Yrs) experience.
- B. Verify that the trees to be planted are acceptable to the City and listed in Section 01565 – Authorized Tree List.

- 3.4 MAINTENANCE OF NEWLY PLANTED TREES AND REPLANTED TREES.
- A. Provide proof of capability to water trees during dry periods.
 - B. Maintain newly planted trees, in healthy condition until end of one-year warranty bond.
 - 1. Straighten leaning trees.
 - 2. Replace dead trees or trees that, in the opinion of the Project Manager, have become unhealthy, unsightly or have lost their natural shape as result of additional growth, improper pruning, maintenance or weather conditions, within four weeks (4 Wks) of notice from the Project Manager.
 - 3. When a tree must be replaced, a new warranty period shall commence on date of tree replacement, and the Project Manager's approval. Minimum warranty period shall be one year (1 Yr).
 - 4. Dispose of rejected trees.

END OF SECTION

REFERENCE STANDARDS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. General quality assurance as related to Reference Standards and a list of references.

1.2 QUALITY ASSURANCE

- A. For products or workmanship specified by association, trade or Federal Standards, comply with requirement of the standard, except when more rigid requirements are specified or are required by applicable code.
- B. Conform to reference standard by date of issue current on the date as stated in the General Conditions.
- C. Request clarification from the Project manager before proceeding should specified reference standards conflict with the Contract Documents.

1.3 SCHEDULE OF REFERENCES

AASHTO American Society of State Highway and Transportation
 Officials
 444 North Capitol Street NW, Suite 249
 Washington, DC 20001-1512
 TEL: (202) 624-5800
 FAX: (202) 624-5806
 WEB: www.transportation.org

ACI American Concrete Institute
 38800 Country Club Drive
 Farmington Hills, MI 48331-34396
 TEL: (248) 848-3700
 FAX: (248) 848-3701
 WEB: www.concrete.org

AGC	Associated General Contractors of America 2300 Wilson Boulevard, Suite 400 Alexandria, VA 22201-5426 TEL: (703) 548-3118 FAX: (703) 548-3119 WEB: www.acg.org
AI	Asphalt Institute 2696 Research Park Drive P. O. Box 14052 Lexington, KY 40511-8480 TEL: (859) 288-4960 FAX: (859) 288-4999 WEB: www.asphaltinstitute.org
AITC	American Institute of Timber Construction 7012 S. Revere Parkway, Suite 140 Englewood, CA 80112-6769 TEL: (303) 792-9559 FAX: (303) 792-0669 WEB: www.aitc-glulam.org
AISC	American Institute of Steel Construction One East Wacker Drive, Suite 700 Chicago, IL 60601-1802 TEL: (312) 670-2400 FAX: (312) 670-5403 WEB: www.aisc.org
AISI	American Iron and Steel Institute 1140 Connecticut Avenue NW, Suite 705 Washington, DC 20036-4011 TEL: (202) 452-7100 WEB: www.steel.org
ASME	American Society of Mechanical Engineers Three Park Avenue New York, NY 10016-5990 TEL: (973) 882-1170 FAX: (973) 882-1717 WEB: www.asme.org

ANSI	American National Standards Institute 1819 L Street NW Sixth Floor Washington, DC 20036-3807 TEL: (202) 293-8020 FAX: (202) 293-9287 WEB: www.ansi.org
APA	American Plywood Association 7011 S. 19th Street Tacoma, WA 98466-5333 TEL: (253) 620-7400 FAX: (253) 565-7265 WEB: www.apawood.org
API	American Petroleum Institute 1220 L Street, NW Washington, DC 20005-4070 TEL: (202) 682-8000 WEB: www.api.org
AREMA	American Railway Engineering and Maintenance-of-Way Association 10003 Derekwood Lane, Suite 210 Lanham, MD 20706-4875 TEL: (301) 459-3200 FAX: (301) 459-8077 WEB: www.arema.org
ASTM	American Society for Testing and Materials 100 Barr Harbor Drive West Conshohocken, PA 19428-2959 TEL: (610) 832-9500 WEB: www.astm.org
AWPA	American Wood Protection Association P.O. Box 361784 Birmingham, AL 35236-1784 TEL: (205) 733-4077 FAX: (205) 733-4075 WEB: www.awpa.com
AWS	American Welding Society 550 NW LeJeune Road Miami, FL 33126-5649 TEL: (305) 443-9353 WEB: www.aws.org

AWWA	American Water Works Association 6666 W Quincy Avenue Denver, CO 80235-3098 TEL: (303) 794-7711 FAX: (303) 794-0804 WEB: www.awwa.org
CFTS	City of Friendswood Technical Specifications City Hall – Community Development Department 910 S. Friendswood Drive Friendswood, TX 77546-4856 TEL: (281) 996-3201 FAX: (281) 996-3260 WEB: www.ci.friendswood.tx.us
CLFMI	Chain Link Fence Manufacturers Institute 10015 Old Columbia Road, Suite B-215 Columbia, MD 21046-1865 TEL: (301) 596-2583 FAX: (301) 596-2594 WEB: www.arcat.com
CRSI	Concrete Reinforcing Steel Institute 933 North Plum Grove Road Schaumburg, IL 60173-4758 TEL: (847) 517-1200 FAX: (847) 517-1206 WEB: www.crsi.org
EJMA	Expansion Joint Manufacturers Association 25 North Broadway Tarrytown, NY 10591-3221 FAX: (914) 332-1541 WEB: www.ejma.org
FS	Federal Standardization Documents General Services Administration Specifications Unit (WFSIS) 7th and D Streets, Southwest Washington, DC 20406-0001 WEB: www.gsa.gov

ICEA	Insulated Cable Engineer Association P. O. Box 1568 Carrollton, GA 30112-0030 TEL: (770) 830-0369 WEB: www.icea.net
IEEE	Institute of Electrical and Electronics Engineers 445 Hoes Lane Piscataway, NJ 08854-4141 TEL: (732) 981-0060 WEB: www.ieee.org
ISA	International Society of Arboriculture P. O. Box 3129 Champaign, IL 61826-3129 TEL: (217) 355-9411 WEB: www.isa-arbor.com
MIL	Military Specifications General Services Administration Specifications Unit (WFSIS) 7th and D Streets, Southwest Washington, DC 20406-0001 WEB: www.gsa.gov
NACE	National Association of Corrosion Engineers 1440 South Creek Drive Houston, TX 77084-4906 TEL: (281) 228-6200 FAX: (281) 228-6300 WEB: www.nace.org
NEMA	National Electrical Manufacturers Association 1300 North 17th Street, Suite 1752 Rosslyn, VA 22209-3806 TEL: (703) 841-3200 FAX: (703) 841-5900 WEB: www.nema.org
NFPA	National Fire Protection Association 1 Batterymarch Park Quincy, MA 02169-7471 TEL: (617) 770-3000 FAX: (617) 770-0700 WEB: www.nfpa.org

NICET	National Institute for Certification in Engineering Technologies 1420 King Street Alexandria, VA 22314-2794 TEL: (888) 476-4238 WEB: www.nicet.org
OSHA	Occupational Safety Health Administration 200 Constitution Avenue, NW Washington, DC 20210-0001 TEL: (800) 321-6742 WEB: www.osha.gov
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077-1053 TEL: (847) 996-6200 FAX: (847) 996-8389 WEB: www.cement.org
PCI	Prestressed Concrete Institute 209 W. Jackson Boulevard, Suite 500 Chicago, IL 60606-6938 TEL: (312) 786-0300 WEB: www.pci.org
SDI	Steel Deck Institute P. O. Box 25 Fox River Grove, IL 60021-0025 TEL: (847) 458-4647 FAX: (847) 458-4648 WEB: www.sdi.org
TAC	Texas Administrative Code Secretary of State P. O. Box 12887 Austin, TX 78711-2887 TEL: (512) 463-0500 WEB: www.sos.state.tx.us
TCEQ	Texas Commission on Environmental Quality P. O. Box 13087 Austin, TX 78711-3087 TEL: (512) 239-1000 WEB: www.tceq.state.tx.us

TxDOT	Texas Department of Transportation 125 East 11th Street Austin, TX 78701-2409 TEL: (512) 305-9500 WEB: www.dot.state.tx.us
UL	Underwriters Laboratories, Inc. 333 Pfingsten Road Northbrook, IL 60062-2096 TEL: (847) 272-8800 FAX: (847) 272-8129 WEB: www.ul.com
UNI-BELL	UNI-BELL Pipe Association 2711 LBJ Freeway, Suite 1000 Dallas, TX 75234-7354 TEL: (972) 243-3902 FAX: (972) 243-3907 WEB: www.uni-bell.org

PART II: PRODUCTS – NOT USED.

PART III: EXECUTION – NOT USED.

END OF SECTION

SECTION 02000 EROSION CONTROL SYSTEMS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Requirements for construction and maintenance of erosion and sedimentation systems control and their components.
- B. Requirements for location and extent of the components of erosion and sedimentation systems.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No payment will be made for erosion control systems under this Section. Include cost in applicable erosion control measures.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 REFERENCES

- A. CFTS – City of Friendswood Technical Specifications.
- B. CFCO – City of Friendswood Code of Ordinances.
- C. EPA – Environmental Protection Agency.
- D. TCEQ – Texas Commission on Environmental Quality.

PART II: PRODUCTS – NOT USED

PART III: EXECUTION

3.1 GENERAL

- A. No clearing and grubbing or rough cutting, other than as specifically directed by the Project Manager to allow soil testing and surveying, shall be permitted until erosion and sedimentation control systems are in place.
- B. All equipment and vehicles used on the construction site shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way, easements or areas of construction.
- C. Damages caused by construction traffic to erosion and sedimentation control systems shall be repaired immediately.
- D. Conduct all construction operation under this Contract in conformance with the erosion control practices described in this Technical Specification.

3.2 EROSION AND SEDIMENTATION CONTROL SYSTEMS REQUIRED FOR CONSTRUCTION OF WATER, SEWER AND DRAINAGE IMPROVEMENTS

A. Storm Sewers

1. Inlet protection barriers shall be constructed prior to commencing work, using either a non-woven geotextile filter fabric silt fence or a straw bale silt fence.
2. Inlet protection barriers shall be constructed prior to commencing work immediately around each completed or partially completed storm manhole or inlet.
3. Contractor shall not leave any storm manhole or inlet unprotected overnight.

B. Sanitary Sewers

1. Under no circumstances shall unfiltered runoff enter the existing sanitary sewer system during construction.
2. Water and sediment removed from any parts of a partially constructed or unaccepted sanitary sewer system shall not be discharged directly into the storm sewer system, unprotected swales or unprotected ditches.
3. Water and sediment shall be discharged into the storm sewer system upstream of inlet protection barriers.

C. Water Distribution System

1. Water used to blow off the system shall be directed to nearby inlets upstream of inlet protection barriers.
2. Water used to blow off the system shall not be directed to existing unprotected swales or unprotected ditches.

D. Place silt fences on downstream side of construction site when shown on the Drawings or when directed by the Project Manager.

E. Compact top layer of any stockpiled excavated material that is to be left on site overnight.

F. Trash pumps shall not discharge directly to any unprotected swale, unprotected ditch or unprotected low lying area.

G. Trash pumps shall discharge upstream of inlet protection barriers or silt fences.

H. The Contractor and the Project Manager shall inspect the erosion and sedimentation control system after each rain, daily during periods of prolonged rainfall and at a minimum of once a week regardless of weather.

I. When damage to sediment control system is discovered, the Contractor shall immediately repair and/or replace damaged components of the system.

J. The Contractor shall remove sediment deposits when the sediment has accumulated to one-half (1/2) the height of any area along any silt fence.

K. Cast and spread sediment deposits within the limits of the construction site as directed by the Project Manager.

3.3 EROSION AND SEDIMENTATION CONTROL SYSTEMS REQUIRED FOR CONSTRUCTION OF PAVING IMPROVEMENTS

- A. Inlet protection barriers shall either be constructed by the paving contractor, or if inlet protection barriers are already in place, the paving contractor shall accept them for maintenance prior to commencing any other construction activities.
- B. Place silt fences on downstream side of construction site when shown on the Drawings or when directed by the Project Manager.
- C. Compact top layer of any stockpiled excavated material that is to be left on site overnight.
- D. Trash pumps shall not discharge directly to any unprotected swale, unprotected ditch or unprotected low-lying area.
- E. Trash pumps shall discharge upstream of inlet protection barriers or silt fences.
- F. Before concrete pavement is placed and curb is completed, all previously constructed inlet protection barriers may be adjusted by the paving contractor.
- G. Storm manholes and inlets shall not be left overnight without inlet protection barriers before placement of concrete pavement and curb is completed.
- H. After placement and curing of the concrete curb, silt fences shall be placed behind the curb.
- I. Remove inlet protection barriers only after construction of the silt fences behind the curb or other protective measures are in place.
- J. The Contractor shall not leave any portion of any street unprotected overnight.
- K. The Contractor and the Project Manager shall inspect the erosion and sedimentation control system after each rain, daily during prolonged periods of rainfall and at a minimum of once a week regardless of the weather.
- L. When damage to sediment control system is discovered, the Contractor shall immediately repair and/or replace damaged components of the system.
- M. The Contractor shall remove sediment deposits when the sediment has accumulated to one-half (1/2) the height of any area along any silt fence.
- N. Cast and spread sediment deposits within the limits of the construction site as directed by the Project Manager.

3.4 MAINTENANCE

- A. The following applies only when a Storm Water Pollution Prevention Program (SWPPP) has been implemented by the Contractor:
 - 1. Unless otherwise directed by the Project Manager, the Contractor shall be responsible for maintenance of the erosion and sedimentation control system until final acceptance of the or until the paving contractor receives notice to proceed.

2. The Project Manager shall walk through the project with the paving contractor and the Design Professional, and together the three (3) parties will observe each component of the erosion and sedimentation control system and agree that either:
 - a. Each component in the system is acceptable and the paving contractor shall assume maintenance responsibilities or,
 - b. List repairs the Contractor must make to each component that is not acceptable before the paving contractor shall assume maintenance responsibilities.
 3. When the paving contractor receives notice to proceed, the Contractor is then responsible for maintaining the existing erosion and sedimentation control system provided that either:
 - a. There are no repairs required by the Contractor or,
 - b. Repairs to the system have been completed by the Contractor.
 4. The paving contractor shall dispose of any component of the system constructed by the Contractor that is not reused in a manner consistent with the purpose of the system.
 5. The paving contractor shall continue maintenance of the erosion and sedimentation control system after final acceptance by the City if so directed by the Project Manager and if included in the bid proposal and unit price description.
 6. The paving contractor shall dispose of the system the Contractor has constructed, when so directed, by the Project Manager.
- B. When a PPP has not been implemented by the WSD (Water, Sewer and/or Drainage) Contractor, the paving Contractor shall be responsible for constructing and maintaining all components required by the PPP.

3.5 DUST CONTROL

- A. Control dust dispersed and movement on construction sites and roads to prevent exposure of soil surfaces, to reduce on and offsite damage, to prevent health hazards, and to improve traffic safety.
- B. Control dust dispersal and movement by utilizing one or more of the following methods:
 1. Mulches bound with chemical binders such as Curasol, Terratack, or equal.
 2. Temporary vegetative cover.
 3. Spray-on adhesives on mineral soils not under traffic loads.
 4. Tillage to roughen surface and bring clods to the surface.
 5. Sprinkling with water to keep top layer moist.
- C. Dust control methods shall be implemented immediately whenever dust can be observed blowing on or off the project site.

END OF SECTION

SECTION 02005 FILTER FABRIC SILT FENCE

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Requirements for the installation, maintenance and removal of erosion and sedimentation control filter fabric silt fence utilized during construction and prior to the final development of the site.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for filter fabric silt fence shall be on a unit price basis. Unit price includes cost of filter fabric fence, staking poles, ditching, and reinforcing. Maintenance during construction and removal of fence are incidental to installation and there shall be no separate pay for these items.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 REFERENCES

- A. ASTM – American Society for Testing and Materials.
 - 1. ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
- B. CFTS – City of Friendswood Technical Specifications.

PART II: PRODUCTS

2.1 MATERIALS

- A. Material shall be Non-woven Geotextile Filter Fabric:
 - 1. Composed of either:
 - a. Polypropylene material;
 - b. Polyethylene material;
 - c. Ethylene material;
 - d. or Polyamide material.
 - 2. Grab strength shall be at least one hundred pounds (100 Lbs) in any principal direction.
 - 3. Mullen burst strength shall exceed two hundred pounds per square inch (200 psi).
 - 4. Equivalent opening size shall be between fifty gallons per minute per square foot (50 gpm/Sf) and one hundred forty gallons per minute per square foot (140 gpm/Sf).

02005-1

5. Water flow rate shall be ten gallons per minute per square foot (10 gpm/Sf) at fifty millimeters (50 mm) constant head as determined by multiplying permittivity (in sec^{-1}) as determined by ASTM D4491 by a conversion factor of seventy-four (74).
 6. Ultraviolet ray inhibitors and stabilizers shall provide a maximum of six months (6 Mos) of expected usable life at a temperature range of zero degrees Fahrenheit (0° F) to one hundred twenty degrees Fahrenheit (120° F).
 7. Ultraviolet radiation stability shall be ninety percent (90%).
 8. Fabric reinforced with support netting shall be reinforced with an industrial polypropylene netting with three-quarter inch ($3/4\text{ In}$) spacing and shall also include a heavy duty nylon top support cord.
- B. Fence Supports
1. Two inch by two inch ($2\text{ In} \times 2\text{ In}$) wooden posts three feet (3 Ft) long or equivalent, and field constructed or;
 2. Factory pre-assembled with support netting and heavy duty nylon top support cord.

PART III: EXECUTION

3.1 GENERAL

- A. Except as otherwise directed or otherwise shown on the Drawings, provide non-woven geotextile filter fabric silt fences to prevent erosion and control sedimentation.
- B. Maintain silt fences until the project is accepted by the City.
- C. At the City's option, silt fences may remain in place after acceptance.
- D. Maintenance and removal of silt fences shall comply with all requirements as specified in Section 02000 – Erosion Control Systems.

3.2 CONSTRUCTION METHODS

- A. Silt fences shall not exceed twenty-four inches (24 In) in height.
- B. Wood posts shall be driven at least twelve inches (12 In) into the ground.
- C. Maximum spacing of wood posts shall be three feet (3 Ft) for field constructed fences and eight feet (8 Ft) for factory pre-assembled silt fences.
- D. Filter fabric shall be stapled using at least one-half inch ($1/2\text{ In}$) staples to the upslope side of the posts.
- E. Anchor the filter fabric by spreading at least eight inches (8 In) of the fabric in a four inch by four inch ($4\text{ In} \times 4\text{ In}$) trench or a four inch (4 In) deep V-trench on the upslope side of the fence.

END OF SECTION

SECTION 02010 STRAW BALE FENCE

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Requirements for the installation of erosion and sedimentation control straw bale fences utilized during construction and prior to the final development of the site.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for straw bale fence shall be on a unit price basis. Unit price includes cost of straw bale fence, staking poles, ditching, and reinforcing. Maintenance during construction and removal of fence are incidental to installation and there shall be no separate pay for these items.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 REFERENCES

- A. CFTS – City of Friendswood Technical Specifications.

PART II: PRODUCTS

2.1 STRAW BALES

- A. Use straw bales bound by either wire, nylon or poly-propylene rope tied across the straw bales.
- B. Do not use straw bales bound with jute, cotton rope or twine.

2.2 ANCHOR STAKES

- A. Bales shall be anchored using three-eighths inch (3/8 In) diameter reinforcing steel bars.
- B. Length of bar shall be thickness of straw bale plus two feet (2 Ft).

PART III: EXECUTION

3.1 GENERAL

- A. Except if otherwise directed or otherwise shown on the Drawings provide straw bale fences to prevent erosion and control sedimentation.
- B. Maintain straw bale fences until the project is accepted by the City.

- C. At City's option, straw bale fences may remain in place after acceptance.
- D. Maintenance and removal of straw bale fences shall comply with all requirements as specified in Section 02000 – Erosion Control Systems.

3.2 CONSTRUCTION METHODS

- A. Excavate four inches (4 In) of material to embed each straw bale in the soil.
- B. Anchor bales securely by driving anchor stakes through the bales and at least two feet (2 Ft) into the ground below the bale.
- C. The first (1st) stake in each bale shall be angled toward the previously laid bale to force bales together.
- D. Fill any gaps between bales with straw to prevent unfiltered runoff from escaping between the bales.
- E. Wedge straw in gaps carefully so as not to separate bales.

END OF SECTION

SECTION 02015 GEOTEXTILE

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Geotextile, also called filter fabric, in applications including pipe embedment wrap, around exterior of tunnel liner, around foundations of pipeline structures and slope stabilization.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment shall be made for work performed under this Section. Include cost of work in unit prices for work requiring geotextile.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 REFERENCES

- A. AASHTO – American Association of State Highway and Transportation Officials.
 - 1. AASHTO M288 – Standard Specification for Geotextile Specification for Highway Applications.
- B. ASTM – American Society for Testing and Materials.
 - 1. ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - 2. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
 - 3. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles (Grab Method).
 - 4. ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of Geotextiles.
 - 5. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.
- C. CFTS – City of Friendswood Technical Specifications.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit standard manufacturer's catalog sheets and other pertinent information, for approval, prior to installation.
- C. Submit installation methods, as part of work plan for tunneling or for excavation and backfill for utilities. Obtain approval from the Project

Manager for filter fabric material and proposed installation method prior to use of filter fabric.

PART II: PRODUCTS

2.1 GEOTEXTILE

- A. Provide geotextile (filter fabric) designed for use in geotechnical applications. Filter fabric shall provide permeable layer or media while retaining soil matrix.
- B. Use fabric which meets physical requirements for Class A subsurface drainage installation conditions as defined in AASHTO M288 and as specified in Paragraph 2.2, Properties.

2.2 PROPERTIES

- A. Material: Nonwoven, nonbiodegradable, fabric consisting of continuous chain polymer filaments or yarns, at least eighty-five percent (85%) by weight polyolefins, polyesters or polyamide, formed into dimensionally stable network.
- B. Chemical Resistance: Inert to commonly encountered chemicals and hydrocarbons over pH range of three (3) to twelve (12).
- C. Physical Resistance: Resistant to mildew and rot, ultraviolet light exposure, insects and rodents.
- D. Minimum Test Values shall be as specified in TABLE 4.1 – MINIMUM TEST VALUES FOR GEOTEXTILE MATERIAL in this section.

PART III: EXECUTION

3.1 GENERAL

- A. Maintain geotextiles until the project is accepted by the City.
- B. At City's option, geotextiles may remain in place after acceptance.
- C. Maintenance and removal of geotextiles shall comply with all requirements as specified in Section 02000 – Erosion Control Systems.

3.2 LINE WORK

- A. Conform use of geotextile to backfill for utilities to Section 02125 – Excavation and Backfill for Utilities.

PART IV: TABLES

4.1 MINIMUM TEST VALUES FOR GEOTEXTILE MATERIAL

PROPERTY	VALUE (MIN.)	TEST METHOD
Grab Strength	180 lbs.	ASTM D4632
Trapezodial Tear Strength	50 lbs.	ASTM D4533
Puncture Strength	80 lbs.	ASTM D4833
Mullen Burst Strength	290 psi.	ASTM D3786
Apparent Opening Size ⁽¹⁾	0.25 mm	ASTM D4751
Permittivity (sec ⁻¹)	0.2	ASTM D4491

⁽¹⁾ Maximum average roll value.

END OF SECTION

SECTION 02020 STABILIZED CONSTRUCTION ACCESS, ROADS, PARKING AND WASH AREAS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Section includes requirements for construction, maintenance and removal of stabilized construction access.
- B. Section includes requirements for construction, maintenance and removal of temporary stabilized roads, parking lots and wash areas.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for stabilized construction access shall be on a unit price basis for each installation.
 - 2. Payment for temporary roads and driveways shall be on a unit basis per installation.
 - 3. No separate measurement and payment shall be made for temporary parking lots or wash areas.
 - 4. No separate measurement and payment shall be made for maintenance or removal or operations listed in this Section.
 - 5. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for Work in this Section shall be included in Total Stipulated Price.

1.3 REFERENCES

- A. CFTS – City of Friendswood Technical Specifications.
- B. EPA – Environmental Protection Agency.
- C. TCEQ – Texas Commission on Environmental Quality.

PART II: PRODUCTS

- A. Permeable separator shall be a geotextile conforming to Section 02015 – Geotextile.
- B. Construction access foundation shall be flexible base, bituminous concrete, cement stabilized base course, portland cement concrete or other material as approved by the Project Manager.
- C. When wood construction entrance/exit is specified in the Drawings they shall conform to the following:
 - 1. Cross timbers surface shall be treated six inch by six inch (6 In x 6 In) railroad ties a minimum of twenty foot (20 Ft) in length.

2. Bracing timber planks shall be two inch by ten inch (2 In x 10 In) treated, #2 grade minimum.

PART III: EXECUTION

3.1 GENERAL

- A. Provide stabilized access, washing areas and/or parking areas at locations shown on the Drawings or as approved by the Project Manager.
- B. Stabilized construction access:
 1. Shall be placed to allow positive drainage from the access to an approved sediment control system.
 2. Shall be a minimum of fifty feet (50 Ft) in length.
 3. Shall have six to one (6:1) approaches on front and back slopes of access containing permeable separator and three inch (3 In) to five inch (5 In) rock with a minimum thickness of eight inches (8 In).
- C. Roads and parking areas shall be graded to provide sufficient drainage away from stabilized areas.
 1. Furnish and place geotextile fabric as a permeable separator to prevent mixing of granular fill with underlying soil.
 2. Place one inch (1 In) to five inch (5 In) granular fill to dimensions and depths shown on the Drawings or as directed by the Project Manager. The minimum thickness shall be eight inches (8 In).
 3. Use sandbags, gravel, boards or similar methods to prevent sediment from entering public rights-of-way, storm drains, ditches and watercourses.
- D. Wash areas shall be graded to provide sufficient drainage away from stabilized areas.
 1. Furnish and place geotextile fabric as a permeable separator to prevent mixing of granular fill with underlying soil.
 2. Place one inch (1 In) to five inch (5 In) granular fill to dimensions and depths shown on the Drawings or as directed by the Project Manager. The minimum thickness shall be eight inches (8 In).
 3. Use sandbags, gravel, boards or similar methods to prevent sediment from entering public rights-of-way, storm drains, ditches and watercourses.

3.2 MAINTENANCE

- A. Inspect and maintain stabilized areas daily. Provide periodic top dressing with additional granular fill as necessary.
- B. Repair or replace components of stabilized access areas that become defective from intended use.
- C. Maintain stabilized access areas as specified in Section 02000 – Erosion Control Systems until acceptance of the Project or as directed by the Project Manager.

- D. Remove stabilized access as specified in Section 02000 – Erosion Control Systems promptly when directed by the Project Manager. Restore areas where stabilized construction access was removed to final project grade in preparation of turf establishment by others.

3.3 DISPOSAL

- A. Remove all waste and sediment material from project conforming with requirements specified in Section 01580 – Waste Material Disposal.

END OF SECTION

SECTION 02025 WATER-PERMEABLE SEDIMENT FILTRATION

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Requirements for the installation of erosion and sedimentation control such as coir logs, excelsior logs, straw lattles, filter socks, or gravel filter bags. Sandbag barriers are not allowed. This protection shall be utilized prior to the final development of the site and during construction, only to be removed after final completion and punch list items are complete.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for the chosen protection shall include and be full compensation for all labor, equipment, materials, supervision, and all incidental expenses for construction of these items, complete in place, including, but not limited to, protection of trees, maintenance requirements, repair and replacement of damaged sections, removal of sediment deposits, and removal of erosion and sedimentation control systems at the end of construction.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 REFERENCES

- A. CFTS – City of Friendswood Technical Specifications.

PART II: PRODUCTS

2.1 LOGS, STRAW LATTLES, AND FILTER SOCKS

- A. Logs, straw lattles, and filter socks shall be installed as shown on the plans and/or as directed by the Engineer. They shall be placed on contour and staked with 24 inch wood stakes or metal pins, at a maximum spacing of four foot on center. The ends of adjacent rolls shall be overlapped on each other a minimum of 1.0'.
- B. Rolls remain on site requiring maintenance by the Contractor throughout the project. Sediment buildup shall be removed when it reaches 1/3 the height of the roll. Any ineffective rolls must be replaced immediately. An ineffective roll is a roll that has flattened out to half its original height. Upon final stabilization it will be the responsibility of the Contractor to remove materials as directed by the Engineer. Disposal shall be the Contractor's responsibility

2.2 GRAVEL BAGS

- A. Materials: Bags shall consist of geotextile fabric (filter fabric) made of longchain synthetic polymers composed of at least 95 percent by weight of polyolefins in a woven fabric. The geotextile fabric shall meet or exceed the following specifications shown in table below:

SILT FENCE GEOTEXTILE FABRIC PROPERTIES			REQUIREMENTS UNSUPPORTED SILT FENCE	
	Units	Supported Silt Fence	Geotextile Elongation ≥50%	Geotextile Elongation <50%
Grab Strength				
Machine Direction	lbs.	90	123	123
X-Machine Direction	lbs.	90	100	100
Permittivity	sec ⁻¹	0.05	0.05	0.05
Apparent Opening Size (Max. Average Roll Value)	mm/sieve	0.6/30	0.6/30	0.6/30
Ultraviolet Stability (Retained Tensile Strength)	%	70 after 500 hrs exposure	70 after 500 hrs exposure	70 after 500 hrs exposure
NOTES: 1. Table 1 adapted from AASHTO M 288 <i>Geotextile Specification for Highway Applications</i> Table 6. Temporary Silt Fence Property Requirements. 2. All numeric values in Table 1 except Apparent Opening Size (AOS) represent minimum average roll values (MARV). Values for AOS represent maximum average roll values.				

- B. Geotextile fabric shall contain stabilizers and/or inhibitors to make the fabric resistant to deterioration resulting from exposure to sunlight or heat. Geotextile fabric shall be resistant to commonly encountered soil chemicals, mildew, rot, and insects. Geotextile fabric shall be free of defects or flaws that affect its physical and/or filtering properties. Geotextile fabric shall provide an expected useable life comparable to the anticipated construction period. The bag size shall be as follows:

Length:	18 to 24 inches
Width:	12 to 18 inches
Thickness:	6 to 8 inches

- C. The bag shall be filled with open-graded gravel and weigh 50 to 75 pounds. The gravel shall be free from adherent coatings, salt, alkali, dirt, clay, or organic and injurious matter. Nylon rope shall be used to secure the closure of the gravel filled bag
- D. Torn or punctured bags shall be replaced immediately.

PART III: EXECUTION

3.1 GENERAL

- A. Maintain protection until the project is accepted by the City.
- B. Maintenance and removal of protection shall comply with all requirements as specified in Section 02000 – Erosion Control Systems.

3.2 CONSTRUCTION METHODS

- A. Provide protection barriers at locations specified on the Drawings. The protection shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.
- B. Inspect protection barrier systems after each rainfall, daily during periods of prolonged rainfall and at a minimum once a week regardless of weather. Repair or replace damaged section immediately to restore the requirements of this Item. Remove sediment deposits when silt reaches one-third of the height of the protection in depth.

END OF SECTION

SECTION 02030 ROCK FILTER DAMS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Section includes requirements for furnishing, installing, maintaining and removing rock filter dams.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Measurement and payment is as noted on the Unit Price Schedule.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
 - 3. Geotextile, excavation and disposal, granular fill and reinforcing wire shall not be measured separately.
 - 4. No separate payment shall be made for removal of accumulated sediment. Maintenance and removal and subsequent reinstallation, if required, of the rock filter dam shall be incidental to the cost of the rock filter dam.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 REFERENCES

- A. ASTM – American Society for Testing and Materials.
 - 1. ASTM A975 – Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire with Polyvinyl Chloride (PVC) Coating).
- B. CFTS – City of Friendswood Technical Specifications.

PART II: PRODUCTS

2.1 GRANULAR FILL

- A. Provide granular fill consisting of concrete or stone. Provide granular fill that is dense, durable and hard material.
- B. Provide granular fill, as shown on the Drawings or as directed by the Project Manager, to the following dimensions:
 - 1. Provide three inch (3 In) to five inch (5 In) granular fill with no material diameter less than three inches (3 In) and no material diameter greater than five inches (5 In).

2.2 WIRE COATING

- A. Style 1 – zinc coated prior to being double twisted into mesh in accordance with ASTM A975.

2.3 WIRE MESH FOR REINFORCEMENT

- A. Provide twenty (20) gauge galvanized double-twisted hexagonal wire mesh and tie wires or as shown on the Construction Plans.

2.4 CONNECTION WIRES AND STIFFENERS

- A. Provide spiral binders, lacing wire and stiffeners made of wire having the same coating material and same wire size as the wire mesh for reinforcement.

2.5 GEOTEXTILE SEPARATION FABRIC

- A. Provide a geotextile of woven or spunbond nonwoven fibers consisting of long-chain synthetic polymers composed of at least ninety-five percent (95%) by weight of polyolefins. Provide geotextile fabric equal as specified in TABLE 4.1 – MINIMUM AVERAGE ROLL VALUE and TABLE 4.2 – MAXIMUM AVERAGE ROLL VALUE in this section.
- B. Refer to Section 02015 – Geotextile for storage and handling precautions and requirements.

PART III: EXECUTION

3.1 GENERAL

- A. Except as otherwise directed or otherwise shown on the Drawings, provide non-woven geotextile filter fabric rock filter dams to prevent erosion and control sedimentation.
- B. Maintain rock filter dams until the project is accepted by the City.
- C. At the City's option, rock filter dams may remain in place after acceptance.
- D. Maintenance and removal of rock filter dams shall comply with all requirements as specified in Section 02000 – Erosion Control Systems.

3.2 SEDIMENT DISPOSAL

- A. Refer to Section 01580 – Waste Material Disposal.

PART IV: TABLES

4.1 MINIMUM AVERAGE ROLL VALUE

MINIMUM AVERAGE ROLL VALUE	
Elongation	< 50 percent
Grab Strength	≥ 200 pounds
Puncture Strength	≥ 75 pounds
UV Stability (retained strength)	≥ 50 percent ¹

¹After five hundred hours (500 Hrs) of exposure.

4.2 MAXIMUM AVERAGE ROLL VALUE

MAXIMUM AVERAGE ROLL VALUE	
Apparent Opening Size	0.212 to 0.6 mm ¹

¹#70 to #30 US sieve.

END OF SECTION

SECTION 02100 CLEARING AND GRUBBING

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Removing surface debris and rubbish.
- B. Clearing site of plant life and grass.
- C. Removing trees and shrubs.
- D. Removing root system of trees and shrubs.
- E. Fence removal.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for clearing and grubbing shall be on a per acre basis.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate clearing work with utility companies.

1.4 REFERENCES

- A. CFTS – City of Friendswood Technical Specifications.

PART II: PRODUCTS – Not Used

PART III: EXECUTION

3.1 PREPARATION

- A. Verify that existing plant life and features designated to remain are identified and tagged.

3.2 PROTECTION

- A. Protect following from damage or displacement:
 - 1. Living trees located three feet (3 Ft) or more outside of intersection of side slopes and original ground line.
 - 2. Plants and landscape features designated to remain.
 - 3. Utilities designated to remain.
 - 4. Benchmarks, monuments, and existing structures designated to remain.

3.3 CLEARING

- A. Remove stumps, main root ball and root system to:
 - 1. Depth of twenty-four inches (24 In) below finished subgrade elevation in area bounded by lines two feet (2 Ft) behind back of curbs.
 - 2. Depth of twenty-four inches (24 In) below finished surface of required cross section for other areas.
- B. Clear undergrowth and deadwood without disturbing subsoil.
- C. Remove vegetation from top soil scheduled for reuse.

3.4 REMOVAL

- A. Remove debris, rubbish and extracted plant material from site in accordance with requirements of Section 01580 – Waste Material Disposal.
- B. Remove on-site fences: Materials generated from removal of fences shall become property of the Contractor. Properly dispose of materials in accordance with applicable local, state and federal laws, or as otherwise directed by the Project Manager.

END OF SECTION

SECTION 02105 REMOVING EXISTING PAVEMENTS AND STRUCTURES

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Removing concrete paving, asphaltic concrete pavement, brick pavement and base courses.
- B. Removing concrete curbs, concrete curbs and gutters, sidewalks and driveways.
- C. Removing pipe culverts, sewers and sewer leads.
- D. Removing existing inlets and manholes.
- E. Removing and disposing of concrete beams, including pre-stressed beams, and drill shafts.
- F. Removing miscellaneous structures constructed of concrete or masonry.
- G. Removing existing bridges.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for removing and disposing of asphaltic surfacing with or without base, regardless of thickness encountered, shall be on a square yard basis measured between lips of gutters.
 - 2. Payment for removing and disposing of reinforced concrete pavement, with or without asphalt overlay, regardless of thickness encountered, shall be on a square yard basis measured from back-to-back of curbs. Payment includes concrete pavement, esplanade curbs, curbs and gutters and paving headers.
 - 3. Payment for removing and disposing of cement stabilized shell base course, with or without asphaltic surfacing, regardless of thickness encountered, shall be on a square yard basis.
 - 4. Payment for removing and disposing of concrete sidewalks and driveways, regardless of thickness encountered, shall be on a square yard basis.
 - 5. Payment for removing asphaltic surface course, regardless of thickness encountered, shall be on a square yard basis paid under item description "Asphalt Surface Mill." This includes removal of existing surface to pavement base.
 - 6. Payment for removing and disposing of miscellaneous concrete and masonry items shall be on a cubic yard basis of structure in place.
 - 7. Payment for removing and disposing of pipes, culverts, sewers and sewer leads shall be on a linear foot basis for each diameter and each material type of pipe removed.
 - 8. Payment for removing and disposing of existing inlets shall be

02105-1

- on unit a price basis for each inlet removed.
- 9. Payment for removing and disposing of concrete piles, including pre-stressed piles, and drill shafts shall be on a linear foot basis.
- 10. Payment for removing and disposing of existing bridges, including piles and abutments to minimum of four feet (4 Ft) below ground level, shall be on a lump sum basis.
- 11. Payment for removing and disposing of existing manholes shall be on a unit price basis for each manhole removed.
- 12. No payment for saw cutting of pavement, curbs or curbs and gutters will be made under this section. Include cost of such work in unit prices for items requiring saw cutting which are listed on the Unit Price Form.
- 13. No payment will be made for work outside maximum payment limits indicated on the Drawings or for pavements, structures or other items removed for the Contractor's convenience.
 - a. For utility installations: Actual pavement replaced should match but not be greater than maximum pavement replacement limits shown on the Drawings. Limits of measurement will be as shown on Street Cut Pavement Replacement Rules.
- 14. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract shall be Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate removal work with utility companies.

1.4 REFERENCES

- A. CTFS – City of Friendswood Technical Specifications.

PART II: PRODUCTS – Not Used

PART III: EXECUTION

3.1 PREPARATION

- A. Obtain advance approval from the Project Manager for dimensions and limits of pavement, structures and other items to be removed.
- B. Identify known utilities below grade. Stake and flag locations.

3.2 PROTECTION

- A. Protect the following from damage or displacement:
 - 1. Adjacent public and private property.

2. Trees, plants and other landscape features designated to remain.
3. Utilities designated to remain.
4. Pavement, structures and other items designated to remain.
5. Bench marks, monuments and other items designated to remain.

3.3 REMOVALS

- A. Remove pavements, structures and other items by methods that will not damage underground utilities. Do not use drop hammer near existing underground utilities.
- B. Minimize amount of earth loaded during removal operations.
- C. Where existing pavement is to remain, make straight saw cuts in existing pavement to provide clean breaks prior to removal. Do not break concrete pavement or base with drop hammer unless concrete or base has been saw cut to minimum depth of two inches (2 In).
- D. When street and driveway saw cut location is greater than one-half (1/2) of pavement lane width, remove pavement for full lane width or to nearest longitudinal joint as directed by the Project Manager.
- E. Remove sidewalks and curbs to nearest existing dummy, expansion or construction joint.
- F. Where existing end of pipe culvert or end of sewer is to remain, install eight inch (8 In) thick masonry plug in pipe end prior to backfill in accordance with requirements of Section 02120 – Excavation and Backfill for Structures.

3.4 BACKFILL

- A. Backfill of areas excavated during removal operations shall be in accordance with requirements of Section 02120 – Excavation and Backfill for Structures.

3.5 DISPOSAL

- A. Inlet frames, grates and plates; and manhole frames and covers may, as directed, remain City property. Disposal shall be in accordance with requirements of Section 01580 – Waste Material Disposal.
- B. Remove from site any debris resulting from work under this section in accordance with requirements of Section 01580 – Waste Material Disposal.

END OF SECTION

SECTION 02120 EXCAVATION AND BACKFILL FOR STRUCTURES

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Excavation, backfilling and compaction of backfill for structures

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. No separate payment will be made for structural excavation and backfill under this Section. Include payment in unit price or lump sum for construction of structures.
2. Refer to Section 01270 – Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum):

1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 DEFINITIONS

A. Unsuitable Material

1. Unsuitable soil materials are the following:
 - a. Materials that are classified as ML, CL-ML, MH, PT, OH and OL according to ASTM D2487.
 - b. Materials that cannot be compacted to required density due to gradation, plasticity or moisture content.
 - c. Materials that contain large clods, aggregates, stones greater than four inches (4 In) in any dimension, debris, vegetation, waste or any other deleterious materials.
 - d. Materials that are contaminated with hydrocarbons or other chemical contaminants.

- B. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement shall be considered suitable, unless otherwise indicated.

- C. Select Material: Material as defined in Section 02140 – Utility Backfill Materials.

- D. Backfill: Select material meeting specified quality requirements, placed and compacted under controlled conditions around structures.

- E. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.

- F. Foundation Base: For foundation base material, use crushed stone aggregate with filter fabric as required, cement-stabilized sand or concrete seal slab. Foundation base provides smooth, level working surface for construction of concrete foundation.
- G. Foundation Subgrade: Foundation subgrade is surface of natural soil which has been excavated and prepared to support foundation base or foundation backfill, where needed.
- H. Ground Water Control Systems: Installations external to excavation such as well points, eductors or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of excavation and depressurization to prevent failure or heaving of excavation bottom. Refer to Section 01585 – Control of Ground and Surface Water.
- I. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from excavation. Remove rain water and surface water which accidentally enters excavation as part of excavation drainage.
- J. Excavation Drainage: Removal of surface and seepage water in excavation by sump pumping and using French drains surrounding foundation to intercept water.
- K. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below foundation as shown on the Drawings and backfilled with foundation backfill material.
- L. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins.

1.4 REFERENCES

- A. ASTM – American Society for Testing and Materials.
 - 1. ASTM D698 – Standard Test Methods for Laboratory Compaction of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600kN-m/m³)).
 - 2. ASTM D1556 – Standard Test Method for Density of Soil in Place by Sand-Cone Method.
 - 3. ASTM D2922 – Standard Test Methods for Density of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
 - 4. ASTM D3017 – Standard Test Method for Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).
 - 5. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- B. CFTS – City of Friendswood Technical Specifications.
- C. TxDOT – Texas Department of Transportation.
 - 1. TxDOT Tex-101-E – Preparing Soil and Flexible Base Materials for Testing.
 - 2. TxDOT Tex-110-E – Particle Size Analysis of Soils.

- D. OSHA – Occupational Safety and Health Administration.
 - 1. Federal Regulations, 29 CFR, Part 1926, Standards – Excavation, Occupational Safety and Health Administration (OSHA).

1.5 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit work plan for excavation and backfill for each structure with complete written description which identifies details of proposed method of construction and sequence of operations for construction relative to excavation and backfill activities. Use descriptions, with supporting illustrations, sufficiently detailed to demonstrate to the Project Manager that procedures meet requirements of the Technical Specifications and the Drawings.
- C. Submit excavation safety system plan.
 - 1. Submit excavation safety system plan in accordance with applicable OSHA requirements for excavations.
 - 2. Submit excavation safety system plan in accordance with requirements of Section 02280 – Trench Safety Systems, for excavations that fall under State and Federal trench safety laws.
- D. Submit ground and surface water control plan in accordance with requirements in this Section and Section 01585 – Control of Ground and Surface Water.
- E. Submit backfill material sources and product quality information in accordance with requirements of Section 02140 – Utility Backfill Materials.
- F. Submit project record documents under provisions of Section 01785 – Project Record Documents. Record location of utilities, as installed, referenced to survey benchmarks. Include location of utilities encountered or rerouted. Give horizontal dimensions, elevations, inverts and gradients.

1.6 TESTS

- A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by the City in accordance with requirements of Sections 01470 – Testing Laboratory Services and 01475 – Quality Control Testing Procedures and as specified in this Section.
- B. Perform embedment and backfill material source qualification testing in accordance with requirements of Section 02140 – Utility Backfill Materials.

PART II: PRODUCTS

2.1 EQUIPMENT

- A. Perform excavation with equipment suitable for achieving requirements of this Specification.
- B. Use equipment which will produce degree of compaction specified. Compact backfill within three feet (3 Ft) of walls with hand operated equipment. Do not use equipment weighing more than ten thousand pounds (10000) closer to walls than a horizontal distance equal to depth of fill at that time. Use hand operated power compaction equipment where use of heavier equipment is impractical or restricted due to weight limitations.

2.2 MATERIAL CLASSIFICATIONS

- A. Use backfill materials conforming to classifications and product descriptions of Section 02140 – Utility Backfill Materials. Use classification or product description for backfill applications as shown on the Drawings and as specified.

PART III: EXECUTION

3.1 PREPARATION

- A. Conduct an inspection to determine condition of existing structures and other permanent installations.
- B. Set up necessary street detours and barricades in preparation for excavation if construction will affect traffic. Conform to requirements of Section 01555 – Traffic Control and Regulation. Maintain barricades and warning devices at all times for streets and intersections where work is in progress or where affected by the Work and such is considered hazardous to traffic movements.
- C. Perform work in accordance with OSHA standards. Employ an excavation safety system as specified in Section 02280 – Trench Safety Systems.
- D. Remove existing pavements and structures, including sidewalks and driveways, in accordance with requirements of Section 02105 – Removing Existing Pavements and Structures.
- E. Install and operate necessary dewatering and surface water control measures in accordance with requirements of Section 01585 – Control of Ground and Surface Water.

3.2 PROTECTION

- A. Protect trees, shrubs, lawns, existing structures and other permanent objects outside of grading limits and within grading limits as designated on the Drawings and in accordance with requirements of Section 01560 – Tree and Plant Protection.

- B. Protect and support above-grade and below-grade utilities which are to remain.
- C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on the Drawings.
- D. Prevent erosion of excavations and backfill. Do not allow water to pond in excavations.
- E. Maintain excavation and backfill areas until start of subsequent work. Repair and recompact slides, washouts, settlements or areas with loss of density at no additional cost to the City.

3.3 EXCAVATION

- A. Perform excavation work so that underground structures can be installed to depths and alignments shown on the Drawings. Use caution during excavation work to avoid disturbing surrounding ground and existing facilities and improvements. Keep excavation to the absolute minimum necessary. No additional payment will be made for excess excavation not authorized by the Project Manager.
- B. Upon discovery of unknown utilities, badly deteriorated utilities, utilities not designated for removal or concealed conditions, discontinue work at that location. Notify the Project Manager and obtain instructions before proceeding in such areas.
- C. Immediately notify agency or company owning any line which is damaged, broken or disturbed. Obtain approval from the Project Manager and agency for any repairs or relocations, whether temporary or permanent.
- D. Avoid settlement of surrounding soil due to equipment operations, excavation procedures, vibration, dewatering or other construction methods.
- E. Provide surface drainage during construction to protect work and to avoid nuisance to adjoining property. Where required, provide proper dewatering and piezometric pressure control during construction.
- F. Conduct hauling operations so that trucks and other vehicles do not create dirt nuisance in streets. Verify that truck beds are sufficiently tight and loaded in such a manner such that objectionable materials will not spill onto streets. Promptly clear away any dirt, mud or other materials that spill onto streets or are deposited onto streets by vehicle tires.
- G. Maintain permanent benchmarks, monumentation and other reference points. Unless otherwise directed, replace those which are damaged or destroyed by the Work.
- H. Provide sheeting, shoring and bracing where required to safely complete the Work, to prevent excavation from extending beyond limits indicated on the Drawings and to protect the Work and adjacent structures or improvements. Use sheeting, shoring and bracing to protect workmen and the general public, and which conforms to requirements of Section 02280 – Trench Safety Systems.

02120-5

- I. Prevent voids from forming outside of sheeting. Immediately fill voids with grout, cement-stabilized sand or other material approved by the Project Manager and compact to ninety-five percent (95%) standard density.
- J. After completion of the structure, remove sheeting, shoring and bracing unless shown on the Drawings to remain in place or directed by the Project Manager in writing that such temporary structures may remain. Remove sheeting, shoring and bracing in such a manner as to maintain safety during backfilling operations and to prevent damage to the Work and adjacent structures or improvements.
- K. Immediately fill and compact voids left or caused by removal of sheeting with cement-stabilized sand or other material approved by the Project Manager and compact to ninety-five percent (95%) standard density.

3.4 HANDLING EXCAVATED MATERIALS

- A. Classify excavated materials: Place material which is suitable for use as backfill in orderly piles at sufficient distance from excavation to prevent slides or cave-ins.
- B. Provide additional backfill material in accordance with requirements of Section 02110 – Borrow, if adequate quantities of suitable material are not available from excavation and trenching operations at site.

3.5 DEWATERING

- A. Provide ground water control per Section 01585 – Control of Ground and Surface Water.
- B. Keep ground water surface elevation minimum of two feet (2 Ft) below bottom of foundation base.
- C. Maintain ground water control as directed by Section 01585 – Control of Ground and Surface Water and until structure is sufficiently complete to provide required weight to resist hydrostatic uplift with minimum safety factor of one and two tenths (1.2).

3.6 FOUNDATION EXCAVATION

- A. Notify the Project Manager at least forty-eight hours (48 Hrs) prior to planned completion of foundation excavations. Do not place foundation base until excavation is accepted by the Project Manager.
- B. Excavate to elevations shown on the Drawings to provide space for foundation base, forming a level undisturbed surface free of mud or soft material. Remove pockets of soft or otherwise unstable soils and replace with foundation backfill material or material as directed by the Project Manager. Prior to placing material over it, recompact subgrade where indicated on the Drawings, scarifying as needed, to ninety-five percent (95%) of maximum Standard Dry Density according to ASTM D698. If specified level of compaction cannot be achieved, moisture condition subgrade and recompact until ninety-five percent (95%) is achieved, over-excavate to provide minimum layer of twenty-four inches (24 In) of

foundation backfill material or other means acceptable to the Project Manager.

- C. Fill unauthorized excessive excavation with foundation backfill material or other suitable material as directed by the Project Manager.
- D. Protect open excavations from rainfall, runoff, freezing groundwater or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition. Keep excavations free of standing water and completely free of water during concrete placement.
- E. Remove soils which become unsuitable due to inadequate dewatering, or other causes, after initial excavation to required subgrade and replace with foundation backfill material, as directed by the Project Manager, at no additional cost to the City.
- F. Place foundation base or foundation backfill material over subgrade where needed, on same day that excavation is completed to final grade. Where base of excavations are left open for longer periods, protect them with seal slab or cement-stabilized sand.
- G. Use filter fabric as specified in Section 02015 – Geotextile to separate crushed aggregate and other free draining Class I materials from native soils or select material backfill. Overlap fabric minimum of twelve inches (12 In) beyond where another material stops contact with soil.
- H. Place crushed aggregate and other Class I materials in uniform layers of eight inch (8 In) maximum thickness. Perform compaction by means of at least two (2) passes of vibratory compactor.

3.7 FOUNDATION BASE.

- A. Place foundation base after subgrade is properly prepared, including placement of foundation backfill where needed. Use foundation base consisting of twelve inch (12 In) layer of crushed stone aggregate or cement-stabilized sand. Alternately, seal slab with minimum thickness of four inches (4 In) may be placed. Extend foundation base minimum of twelve inches (12 In) beyond edge of structure foundation, unless shown otherwise on the Drawings.
- B. Where foundation base and foundation backfill are of same material, both can be placed in one (1) operation.

3.8 BACKFILL

- A. Complete backfill to surface of natural ground or to lines and grades shown on the Drawings. Remove forms, lumber, trash and debris from structures. Use select fill for backfill. Existing material that qualifies as select material may be used, unless indicated otherwise on the Drawings. Deposit backfill in uniform layers and compact each layer as specified.
- B. Do not place backfill against concrete walls or similar structures until laboratory test breaks indicate that concrete has reached minimum of eighty-five percent (85%) of specified compressive strength. Where walls are supported by slabs or intermediate walls, do not begin backfill

operations until slab or intermediate walls have been placed and concrete has attained sufficient strength.

- C. Remove concrete forms before starting backfill and remove shoring and bracing as work progresses.
- D. Maintain backfill material at plus or minus three percent ($\pm 3\%$) of optimum moisture content, unless otherwise approved by the Project Manager. Place fill material in uniform eight inch (8 In) maximum loose layers. Compact fill to at least ninety-five percent (95%) of maximum Standard Proctor Density according to ASTM D698 below paved areas. Compact fill to at least ninety-five percent (95%) around structures below unpaved areas.
- E. Where backfill is placed against sloped excavation surface, run compaction equipment across boundary of cut slope and backfill to form compacted slope surface for placement of next layer of backfill.
- F. Place backfill using cement-stabilized sand in accordance with Section 02145 – Cement-Stabilized Sand.
- G. Hydraulic or pneumatic equipment shall be used for all backfill operations. At no time shall the lift exceed the specifications above, even when using heavy construction equipment as a compact device.

3.9 FIELD QUALITY CONTROL

- A. Testing shall be performed under provisions of Sections 01470 – Testing Laboratory Services and 01475 – Quality Control Testing Procedures.
- B. Tests shall be performed initially on minimum of one (1) different sample of each material type for plasticity characteristics, in accordance with ASTM D4318 and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is a noticeable change in material gradation or plasticity.
- C. In-place density tests of compacted subgrade and backfill shall be performed according to ASTM D1556 or ASTM D2922 and ASTM D3017 and at following frequencies and conditions:
 - 1. Minimum of one (1) test for each lift of bedding and backfill material at intervals of five hundred feet (500 Ft) measured along the trench centerline or between every manhole, whichever results in greatest number of density tests, as determined by the Project Manager.
 - 2. A minimum of three (3) density tests for each full work shift.
 - 3. Density tests shall be performed in all placement areas.
 - 4. Number of tests shall be increased when inspection determines that soil types or moisture contents are not uniform or when compacting effort is variable and not considered sufficient to attain uniform density.
 - 5. Identify elevation of test with respect to natural ground.
 - 6. Record approximate depth of lift tested.
- D. At least one (1) test for moisture-density relationships shall be initially performed for each type of backfill material in accordance with ASTM

D698. Perform additional moisture-density relationship test once a month or whenever there is noticeable change in material gradation or plasticity.

- E. When tests indicate work does not meet specified compaction requirements, recondition, recompact and retest at Contractor's expense.

3.10 DISPOSAL OF EXCESS MATERIAL

- A. Excess material shall be the property of the Contractor and shall be disposed of properly with no cost to the City. Dispose of excess materials in accordance with requirements of Section 01580 – Waste Material Disposal.

END OF SECTION

SECTION 02125 EXCAVATION AND BACKFILL FOR UTILITIES

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Excavation, trenching, foundation, embedment and backfill for installation of utilities, including manholes and other related structures.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

- 1. No separate payment will be made for trench excavation, embedment and backfill under this Section. Include cost in unit price for installed underground piping, sewer, conduit or duct work.
- 2. When the Project Manager directs the Contractor to over-excavate trench bottom, the Contractor shall be paid by the unit price bid per linear foot under Bid Item – Six inches (6 In) over-excavation of Trench Bottom.
 - a. No payment shall be paid if the Project Manager does not direct the Contractor to over-excavate trench bottom.
 - b. No over excavation shall be measured or paid when unsuitable conditions result from dewatering system not in conformance with Section 01585 – Control of Ground and Surface Water.
- 3. No separate payment shall be made for performing Critical Location exploratory excavation. Include cost in the unit price for work requiring critical location.
- 4. Refer to Section 01270 – Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum):

- 1. If Contract is Stipulated Price Contract, payment for Work in this Section shall be included in Total Stipulated Price.

1.3 DEFINITIONS

- A. Pipe Foundation: Suitable and stable native soils that are exposed at trench subgrade after excavation to depth of bottom of bedding as shown on the Drawings or foundation backfill material placed and compacted in over-excavations.
- B. Pipe Bedding: Portion of trench backfill that extends vertically from top of foundation up to level line at bottom of pipe and horizontally from one (1) trench sidewall to opposite sidewall.
- C. Haunching: Material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one (1) trench sidewall to opposite sidewall.

- D. Initial Backfill: Portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to level line twelve inches (12 In) above top of pipe and horizontally from one (1) trench sidewall to opposite sidewall.
- E. Pipe Embedment: Portion of trench backfill that consists of bedding, haunching and initial backfill.
- F. Trench Zone: Portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.
- G. Unsuitable Material: Unsuitable soil materials are the following:
 - 1. Materials that are classified as ML, CL-ML, MH, PT, OH and OL according to ASTM D2487.
 - 2. Materials that cannot be compacted to required density due to gradation, plasticity or moisture content.
 - 3. Materials that contain large clods, aggregates, stones greater than two inches (2 In) in any dimension, debris, vegetation, waste or any other deleterious materials.
 - 4. Materials that are contaminated with hydrocarbons or other chemical contaminants.
- H. Suitable Material: Suitable soil materials are those meeting specification requirements. Materials mixed with lime or cement that can be compacted to required density and meeting requirements for suitable materials may be considered suitable materials, unless otherwise indicated.
- I. Backfill: Suitable material meeting specified quality requirements placed and compacted under controlled conditions.
- J. Ground Water Control Systems: Installations external to trench, such as well points, eductors or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation and depressurization to prevent failure or heaving of excavation bottom. Refer to Section 01585 – Control of Ground and Surface Water.
- K. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as part of excavation drainage.
- L. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using drainage layer, as defined in ASTM D2321, placed on foundation beneath pipe bedding or thickened bedding layer of Class I material.
- M. Trench Conditions are defined with regard to stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.
 - 1. Dry Stable Trench: Stable and substantially dry trench

- conditions exist in pipe embedment zone as result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.
2. Stable Trench with Seepage: Stable trench in which ground water seepage is controlled by excavation drainage.
 - a. Stable Trench with Seepage in Clay Soils: Excavation drainage is provided in lieu of or to supplement ground water control systems to control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.
 - b. Stable Wet Trench in Sandy Soils: Excavation drainage is provided in embedment zone in combination with ground water control in predominately sandy or silty soils.
 - N. Unstable Trench: Unstable trench conditions exist in pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.
 - O. Sub-trench: Sub-trench is special case of benched excavation. Sub-trench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of sub-trench depends upon trench stability and safety as determined by Contractor.
 - P. Trench Dam: Placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along trench.
 - Q. Over-excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on the Drawings and backfilled with foundation backfill material.
 - R. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.
 - S. Trench Safety Systems include both protective systems and shoring systems as defined in Section 02280 – Trench Safety Systems.
 - T. Trench Shield (Trench Box): Portable worker safety structure moved along trench as work proceeds, used as protective system and designed to withstand forces imposed on it by cave-in, thereby protecting persons within trench. Trench shields may be stacked if so designed or placed in series depending on depth and length of excavation to be protected.
 - U. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins or to prevent movement of ground affecting adjacent installations or improvements.
 - V. Special Shoring: Shoring system meeting special shoring as specified in

Paragraph 1.8, Special Shoring Design Requirements, for locations identified on the Drawings.

1.4 REFERENCES

- A. ASTM – American Society for Testing and Materials.
 - 1. ASTM C12 – Standard Practice for Installing Vitrified Clay Pipe Lines.
 - 2. ASTM D558 – Standard Test Methods for Moisture-Density Relations of Soil Cement Mixtures.
 - 3. ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft).
 - 4. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
 - 5. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.
 - 6. ASTM D2487 – Standard Classification of Soils for Engineering Purposes.
 - 7. ASTM D2922 – Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 8. ASTM D3017 – Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
 - 9. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- B. CFTS – City of Friendswood Technical Specifications.
- C. OSHA – Occupational Safety and Health Administration.
 - 1. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).
- D. TxDOT – Texas Department of Transportation.
 - 1. TxDOT Tex-101-E – Preparing Soil and Flexible Base Materials for Testing.
 - 2. TxDOT Tex-110-E – Particle Size Analysis of Soils.

1.5 SCHEDULING

- A. Schedule work so that pipe embedment can be completed on same day that acceptable foundation has been achieved for each section of pipe installation, manhole or other related structures.

1.6 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit planned typical method of excavation, backfill placement and compaction including:
 - 1. Trench widths.
 - 2. Procedures for foundation and pipe zone bedding placement and trench backfill compaction.
 - 3. Procedures for assuring compaction against undisturbed soil

when pre-manufactured trench safety systems are proposed.

- C. Submit backfill material sources and product quality information in accordance with requirements of Section 02140 – Utility Backfill Materials.
- D. Submit trench excavation safety program in accordance with requirements of Section 02280 – Trench Safety Systems. Include designs for special shoring meeting requirements defined in Paragraph 1.8, Special Shoring Design Requirements contained herein.
- E. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts and gradients.
- F. Submit eleven inch by seventeen inch (11 In x 17 In) copy of the Drawing with plotted utility or obstruction location titled "Critical Location Report" to the Project Manager.

1.7 TESTING

- A. Testing and analysis of backfill materials for soil classification and compaction during construction shall be performed by an independent laboratory in accordance with requirements of Sections 01470 – Testing Laboratory Services and 01475 – Quality Control Testing Procedures and as specified in this Section.
- B. Perform backfill material source qualification testing in accordance with requirements of Section 02140 – Utility Backfill Materials.

1.8 SPECIAL SHORING DESIGN REQUIREMENTS

- A. Have special shoring designed or selected by the Contractor's Professional Engineer to provide support for sides of excavations, including soils and hydrostatic ground water pressures as applicable and to prevent ground movements affecting adjacent installations or improvements such as structures, pavements and utilities. Special shoring may be a premanufactured system selected by the Contractor's Professional Engineer licensed by the State of Texas to meet project site requirements based on manufacturer's standard design.

PART II: PRODUCTS

2.1 EQUIPMENT

- A. Perform excavation with hydraulic excavator or other equipment suitable for achieving requirements of this Section.
- B. Use only hand-operated pneumatic or hydraulic tamping equipment until minimum cover of twelve inches (12 In) is obtained over pipes, conduits and ducts. Do not use heavy compacting equipment until adequate cover is attained to prevent damage to pipes, conduits or ducts.
- C. Use trench shields or other protective systems or shoring systems which are designed and operated to achieve placement and compaction of

backfill directly against undisturbed native soil.

- D. Use special shoring systems where required which may consist of braced sheeting, braced soldier piles and lagging, slide rail systems or other systems meeting requirements as specified in Paragraph 1.8, Special Shoring Design Requirements.

2.2 MATERIAL CLASSIFICATIONS

- A. Embedment and Trench Zone Backfill Materials: Conform to classifications and product descriptions of Section 02140 – Utility Backfill Materials.
- B. Concrete Backfill: Conform to requirements for Class A concrete as specified in Section 03300 – Structural Concrete.
- C. Geotextile (Filter Fabric): Conform to requirements of Section 02015 – Geotextile.
- D. Concrete for Trench Dams: Concrete backfill or three (3) sack premixed (bag) concrete.
- E. Timber Shoring Left in Place: Untreated oak.

PART III: EXECUTION

3.1 STANDARD PRACTICE

- A. Install flexible pipe, including "semi-rigid" pipe, to conform to standard practice described in ASTM D2321 and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.
- B. Install rigid pipe to conform to standard practice described in ASTM C12 and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.
- C. Classification of material will be determined by the Project Manager.

3.2 PREPARATION

- A. Establish traffic control to conform to requirements of Section 01555 – Traffic Control and Regulation. Maintain barricades and warning lights for streets and intersections affected by the Work and are considered hazardous to traffic movements.
- B. Perform work to conform to applicable safety standards and regulations. Employ trench safety system as specified in Section 02280 – Trench Safety Systems.
- C. Immediately notify agency or company owning any existing utility line which is damaged, broken or disturbed. Obtain approval from the Project Manager and agency for any repairs or relocations, either temporary or permanent.
- D. Remove existing pavements and structures, including sidewalks and driveways, to conform to requirements of Section 02105 – Removing

Existing Pavements and Structures, as applicable.

- E. Install and operate necessary dewatering and surface-water control measures to conform to Section 01585 – Control of Ground and Surface Water. Provide stable trench to allow installation in accordance with the Technical Specifications.
- F. Maintain permanent benchmarks, monumentation and other reference points. Unless otherwise directed in writing, replace those which are damaged or destroyed in accordance with Section 01725 – Field Surveying.

3.3 CRITICAL LOCATION INVESTIGATION

- A. Horizontal and vertical location of various underground lines shown on the Drawings, including but not limited to water lines, gas lines, storm sewers, sanitary sewers, telecommunication lines, electric lines or power ducts, pipelines, concrete and debris, are based on best information available but are only approximate locations. **At Critical Locations shown on the Drawings, field verify horizontal and vertical locations of such lines within zone two feet (2 Ft) vertically and four feet (4 Ft) horizontally of the proposed work.**
 - 1. Verify location of existing utilities a minimum of seven working days (7 wD) in advance of pipe laying activities based on daily pipe laying rate. Use extreme caution and care when uncovering these lines.
 - 2. Notify the Project Manager in writing immediately upon identification of obstruction. In event of failure to identify obstruction a minimum of seven days (7 D) in advance, the Contractor shall not be entitled to extra cost for downtime including, but not limited to, payroll, equipment, overhead, demobilization and remobilization, until seven days (7 D) has passed from the time the Project Manager is notified of obstruction.
 - 3. **Verify all locations where there is specified to be a tie-in into existing utilities or infrastructure before the start of excavation, so as to verify all grades and locations.** Failure to do so shall result in the replacement of the installed work at the Contractor's cost for any work installed before finding an error in elevations or locations.
- B. Notify involved utility companies of date and time that excavation will occur and request that their respective utility lines be marked in field. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide the Project Manager with at least forty-eight hours (48 Hrs) notice prior to excavation or related work.
- C. Survey vertical and horizontal locations of obstructions relative to project baseline and datum and plot results on eleven inch by seventeen inch (11 In x 17 In) copy of the Drawings. For large diameter water lines,

submit to the Project Manager for approval, with horizontal and vertical alignment dimensions for connections to existing lines tied into project baseline, and signed and sealed by Registered Professional Land Surveyor (R.P.L.S.) licensed by the State of Texas.

3.4 PROTECTION

- A. Protect trees, shrubs, lawns, existing structures and other permanent objects outside of grading limits and within grading limits as designated on Drawings and in accordance with requirements of Section 01560 – Tree and Plant Protection.
- B. Protect and support above-grade and below-grade utilities which are to remain.
- C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on the Drawings.
- D. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements or areas with loss of density or pavement failures or potholes occur, repair, recompact and pave those areas at no additional cost to the City.

3.5 EXCAVATION

- A. Except as otherwise specified or shown on the Drawings, install underground utilities in open cut trenches with vertical sides.
- B. Perform excavation work so that pipe, conduit and ducts can be installed to depths and alignments shown on the Drawings. Avoid disturbing surrounding ground and existing facilities and improvements.
- C. Determine trench excavation widths using TABLE 4.1 – TRENCH EXCAVATION WIDTHS as related to pipe outside diameter (O.D.), in this Section.
- D. Use sufficient trench width or benches above embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from surface elevation. Provide sufficient space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment and backfill and other materials.
- E. Upon discovery of unknown utilities, badly deteriorated utilities, utilities not designated for removal or concealed conditions, discontinue work at that location. Notify the Project Manager and obtain instructions before proceeding.
- F. Shoring of Trench Walls.
 - 1. Install Special Shoring in advance of trench excavation or simultaneously with trench excavation, so that soils within full height of trench excavation walls will remain laterally supported at all times.
 - 2. For all types of shoring, support trench walls in pipe embedment zone throughout installation. Provide trench wall supports

- sufficiently tight to prevent washing trench wall soil out from behind trench wall support.
- 3. Leave sheeting driven into or below pipe embedment zone in place to preclude loss of support of foundation and embedment materials, unless otherwise directed by the Project Manager. Leave rangers, walers and braces in place as long as required to support sheeting, which has been cut off and trench wall in vicinity of pipe zone.
- 4. Employ special methods for maintaining integrity of embedment or foundation material. Before moving supports, place and compact embedment to sufficient depths to provide protection of pipe and stability of trench walls. As supports are moved, finish placing and compacting embedment.
- 5. If sheeting or other shoring is used below top of pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of removable sheeting extending into embedment zone shall be equivalent of one inch (1 In) thick steel plate. As sheeting is removed, fill in voids left with grouting material.
- G. Use of Trench Shields: When trench shield (trench box) is used as worker safety device, the following requirements apply:
 - 1. Make trench excavations of sufficient width to allow shield to be lifted or pulled freely, without damage to trench sidewalls.
 - 2. Move trench shields so that pipe and backfill materials, after placement and compaction, are not damaged nor disturbed, nor degree of compaction reduced. Re-compact after shield is moved if soil is disturbed.
 - 3. When required, place, spread and compact pipe foundation and bedding materials beneath shield. For backfill above bedding, lift shield as each layer of backfill is placed and spread. Place and compact backfill materials against undisturbed trench walls and foundation.
 - 4. Maintain trench shield in position to allow sampling and testing to be performed in safe manner.
 - 5. Conform to applicable Government regulations.
- H. Voids under paving area outside shield caused by the Contractor's work will require removal of pavement, consolidation and replacement of pavement in accordance with the Contract Documents. Repair damage resulting from failure to provide adequate supports.
- I. Place sand or soil behind shoring or trench shield to prevent soil outside shoring from collapsing and causing voids under pavement. Immediately pack suitable material in outside voids following excavation to avoid caving of trench walls.
- J. Coordinate excavation within fifteen feet (15 Ft) of any products pipeline with company's representative. Support pipeline with methods agreed to by the Pipeline Company's representative. Use small, rubber tired

excavator such as a backhoe, to do exploratory excavation. Bucket that is used to dig in close proximity to pipelines shall not have teeth or shall have guard installed over teeth to approximate bucket without teeth. Excavate by hand within one foot (1 Ft) of the pipeline. Do not use larger excavation equipment than normally used to dig trench in vicinity of pipeline until pipelines have been uncovered and fully exposed. Do not place large excavation and hauling equipment directly over pipelines unless approved by the Pipeline Company's representative.

- K. When, during excavation to uncover pipelines, a screwed collar or an oxyacetylene weld is exposed, immediately notify the Project Manager. Provide supports for collar or welds. Discuss with the Pipeline Company's representative and determine methods of supporting collar or weld during excavation and later backfilling operations. When collar is exposed, request the Pipeline Company to provide welder in a timely manner to weld ends of collar prior to backfilling of excavation.

3.6 HANDLING EXCAVATED MATERIALS

- A. Use only excavated materials, which are suitable as defined in this Section and conforming to Section 02140 – Utility Backfill Materials. Place material suitable for backfilling in stockpiles at distance from trench to prevent slides or cave-ins.
- B. When required, provide additional backfill material conforming to requirements of Section 02140 – Utility Backfill Materials.
- C. Do not place stockpiles of excess excavated materials on streets and adjacent properties. Protect backfill material to be used on site. Maintain site conditions in accordance with Section 01505 – Temporary Facilities and Controls. Excavate trench so that pipe is centered in trench. Do not obstruct sight distance for vehicles utilizing roadway or detours with stockpiled materials.

3.7 TRENCH FOUNDATION

- A. Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.
- B. When wet soil is encountered on trench bottom and dewatering system is not required, over excavate an additional six inches (6 In) with approval by the Project Manager. Place non-woven geotextile fabric and then compact twelve inches (12 In) of crushed stone in one lift on top of fabric. Compact crushed stone with four (4) passes of vibratory-type compaction equipment.
- C. Perform over-excavation, if directed by the Project Manager, in accordance with Paragraph 3.7.B above. Removal of unstable or unsuitable material may be required if approved by the Project Manager;
 - 1. Even though the Contractor has not determined material to be unsuitable or;
 - 2. If unstable trench bottom is encountered and an adequate

ground water control system is installed and operating according to Section 01585 – Control of Ground and Surface Water.

- D. Place trench dams in Class I foundations in line segments longer than one hundred feet (100 Ft) between manholes and not less than one (1) in every five hundred feet (500 Ft) of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than five feet (5 Ft) from manholes.

3.8 PIPE EMBEDMENT, PLACEMENT AND COMPACTION

- A. Remove loose, sloughing, caving or otherwise unsuitable soil from bottoms and sidewalls of trenches immediately prior to placement of embedment materials.
- B. Place embedment including bedding, haunching and initial backfill as shown on the Drawings.
- C. For pipe installation, manually spread embedment materials around pipe to provide uniform bearing and side support when compacted. Protect flexible pipe from damage during placing of pipe zone bedding material. Perform placement and compaction directly against undisturbed soils in trench sidewalls or against sheeting which is to remain in place.
- D. Do not place trench shields or shoring within height of embedment zone unless means to maintain density of compacted embedment material are used. If moveable supports are used in embedment zone, lift supports incrementally to allow placement and compaction of material against undisturbed soil.
- E. Place geotextile to prevent particle migration from in-situ soil into open-graded (Class I) embedment materials or drainage layers.
- F. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.
- G. Place haunching material manually around pipe and compact it to provide uniform bearing and side support. If necessary, hold small-diameter or lightweight pipe in place during compaction of haunch areas and placement beside pipe with sand bags or other suitable means.
- H. Place electrical conduit, if used, directly on foundation without bedding.
- I. Shovel in-place and compact embedment material using pneumatic or hydraulic tampers in restricted areas and vibratory-plate compactors or engine-powered jumping jacks in unrestricted areas. Compact each lift before proceeding with placement of next lift. Water tamping or jetting shall not allowed.
- J. For water lines construction embedment, use bank run sand concrete sand gem sand pea gravel or crushed limestone as specified in Section 02140 – Utility Backfill Material. For water lines adhere to the following subparagraph numbers 1 and 2; for utility installation other than water, adhere to numbers 3 and 4 below:
 - 1. Class I, II and III Embedment Materials:
 - a. Maximum six inches (6 In) compacted lift thickness.

- b. Compact to achieve minimum of ninety-five percent (95%) of maximum dry density as determined according to ASTM D698.
 - c. Moisture content to be within plus or minus three percent ($\pm 3\%$) of optimum as determined according to ASTM D698, unless otherwise approved by the Project Manager.
 - 2. Cement-Stabilized Sand (where required for special installations):
 - a. Maximum six inches (6 In) compacted thickness.
 - b. Compact to achieve minimum of ninety-five percent (95%) of maximum dry density as determined according to ASTM D698.
 - c. Moisture content to be on dry side of optimum as determined according to ASTM D698 but sufficient for effective hydration.
 - 3. Class I Embedment Materials:
 - a. Maximum six inches (6 In) compacted lift thickness.
 - b. Systematic compaction by at least two (2) passes of vibrating equipment. Increase compaction effort as necessary to effectively embed pipe to meet deflection test criteria.
 - c. Moisture content as determined by the Contractor for effective compaction without softening soil of trench bottom, foundation or trench walls.
 - 4. Class II Embedment and Cement-Stabilized Sand:
 - a. Maximum six inches (6 In) compacted thickness.
 - b. Compaction by methods determined by the Contractor to achieve minimum of ninety-five percent (95%) of maximum dry density as determined according to ASTM D698 for Class II materials and according to ASTM D558 for Cement-Stabilized materials.
 - c. Moisture content of Class II materials within three percent ($\pm 3\%$) of optimum as determined according to ASTM D698. Moisture content of Cement-Stabilized sands on dry side of optimum as determined according to ASTM D558 but sufficient for effective hydration.
- K. Place trench dams in Class I embedment in line segments longer than one hundred feet (100 Ft) between manholes and not less than one (1) in every five hundred feet (500 Ft) of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than five feet (5 Ft) from manholes.

3.9 TRENCH ZONE BACKFILL PLACEMENT AND COMPACTION

- A. Place backfill for pipe or conduits and restore surface as soon as practicable. Leave only minimum length of trench open as necessary for

construction.

- B. For water lines, backfill in trench zone, including auger pits, intermediate and site pits, with bank run sand select fill or random backfill material as specified in Section 02140 – Utility Backfill materials.
- C. For sewer pipes, use backfill materials described by trench limits. For "trench zone backfill" under pavement and to within one foot (1 Ft) back of curb, use Cement-Stabilized sand for pipes of nominal sizes thirty-six inches (36 In) in diameter and smaller to level twelve inches (12 In) below the pavement. For sewer pipes forty-two inches (42 In) in diameter and larger, under pavement or natural ground, in satisfactory soil conditions, backfill from twelve inches (12 In) above top of pipe to twelve inches (12 In) below pavement with suitable on-site material or select backfill. For sewer pipes forty-two inches (42 In) in diameter and larger, under pavement or natural ground, in unsatisfactory soil conditions, backfill from twelve inches (12 In) above top of pipe to twelve inches (12 In) below pavement with suitable on-site material or select backfill. Use select backfill for rigid pavements or flexible base material for asphalt pavements for twelve (12) inch backfill directly under pavement. For backfill materials reference Section 02140 – Utility Backfill Materials.
- D. Where damage to completed pipe installation work is likely to result from withdrawal of sheeting, leave sheeting in place. Cut off sheeting one and one-half feet (1-1/2 Ft) or more above crown of pipe. Remove trench supports within five feet (5 Ft) from ground surface.
- E. When shown on Drawings, random backfill of suitable material may be used in trench zone for trench excavations outside pavements.
- F. Place trench zone backfill in lifts and compact. Fully compact each lift before placement of next lift.
 - 1. Class I, II, III or IV or combination thereof (Random Backfill):
 - a. Maximum eight inches (8 In) compacted lift thickness.
 - b. Compact by vibratory equipment to minimum of ninety-five percent (95%) of maximum dry density determined according to ASTM D698.
 - c. Moisture content within plus or minus three percent ($\pm 3\%$) of optimum determined according to ASTM D698, unless otherwise approved by the Project Manager.
 - 2. Cement-Stabilized Sand:
 - a. Maximum lift thickness determined by the Contractor to achieve uniform placement and required compaction, but not to exceed twelve inches (12 In).
 - b. Compact by vibratory equipment to minimum of ninety-five percent (95%) of maximum dry density determined according to ASTM D558.
 - c. Moisture content on dry side of optimum determined according to ASTM D558 but sufficient for cement hydration.
 - 3. Select Backfill:

- a. Place in maximum eight inch (8 In) loose layers.
 - b. Compaction by equipment providing tamping or kneading impact to minimum of ninety-five percent (95%) of maximum dry density determined according to ASTM D698.
 - c. Moisture content within plus or minus three percent ($\pm 3\%$) above optimum determined according to ASTM D698, unless approved by the Project Manager.
- G. Unless otherwise shown on the Drawings, for trench excavations not under pavement or in the right of way, random backfill of suitable material may be used in trench zone as directed by the Project Manager.
 - 1. Fat clays (CH) may be used as trench zone backfill outside paved areas at the Contractor's option. When required density is not achieved, rework, dry out, use lime stabilization or other approved methods to achieve compaction requirements or use different suitable material at no additional cost to the City.
 - 2. Maximum eight inch (8 In) compacted lift thickness for clayey soils and maximum eight inch (8 In) lift thickness for granular soils.
 - 3. Compact to minimum of ninety percent (90%) of maximum dry density determined according to ASTM D698.
 - 4. Moisture content as necessary to achieve density.
- H. For electric conduits, remove form work used for construction of conduits before placing trench zone backfill.
- I. Water soaking, jetting or compaction by backhoe bucket is not acceptable and shall not be used.

3.10 MANHOLES, JUNCTION BOXES AND OTHER PIPELINE STRUCTURES

- A. Meet requirements of adjoining utility installations for backfill of pipeline structures, as shown on the Drawings.
- B. Below paved areas, encapsulate manhole with Cement-Stabilized sand; minimum of one foot (1 Ft) below base, minimum one foot (1 Ft) around walls, up to within twelve inches (12 In) of pavement subgrade. Compact in accordance with Paragraph 3.9.F.2 of this Section.
- C. In unpaved areas, use select fill for backfill. Existing material that qualifies as select material may be used, unless indicated otherwise on the Drawings. Deposit backfill in uniform layers and compact each layer as specified. Maintain backfill material at plus or minus three percent ($\pm 3\%$) of optimum moisture content, unless otherwise approved by the Project Manager. Place fill material in uniform eight inch (8 In) maximum loose layers. Compact fill to at least ninety-five percent (95%) of maximum Standard Proctor Density according to ASTM D698.

3.11 FIELD QUALITY CONTROL

- A. Test for material source qualifications as defined in Section 02140 – Utility Backfill Materials.

- B. Provide excavation and trench safety systems at locations and to depths required for testing and retesting during construction at no additional cost to the City.
- C. Tests will be performed on minimum of three (3) different samples of each material type for plasticity characteristics, in accordance with ASTM D4318 and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests shall be performed whenever there is noticeable change in material gradation or plasticity or when requested by the Project Manager.
- D. At least three (3) tests for moisture-density relationships shall be performed initially for backfill materials in accordance with ASTM D698 and for cement-stabilized sand in accordance with ASTM D558. Perform additional moisture-density relationship tests once a month or whenever there is noticeable change in material gradation or plasticity.
- E. In-place density tests of compacted pipe foundation, embedment and trench zone backfill soil materials shall be performed according to ASTM D1556 or ASTM D2922 and ASTM D3017 and at following frequencies and conditions:
 - 1. For open cut construction projects and auger pits: Unless otherwise approved by the Project Manager, successful compaction to be measured by one (1) test per one hundred linear feet (100 Lf) measured along pipe for compacted embedment and one (1) test per one hundred linear feet (100 Lf) measured along pipe for compacted trench zone backfill material and one (1) test at each auger pit.
 - 2. A minimum of three (3) density tests for each full shift of Work.
 - 3. Density tests shall be distributed among placement areas. Placement areas are: foundation, bedding, haunching, initial backfill and trench zone.
 - 4. The number of tests shall be increased if inspection determines that soil type or moisture content are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density, as specified.
 - 5. Density tests at various depths below fill surface, if required, shall be performed by pit excavation. Material in previously placed lifts may therefore be subject to acceptance/rejection.
 - 6. Two (2) verification tests shall be performed adjacent to in-place tests showing density less than acceptance criteria. Placement will be rejected unless both verification tests show acceptable results.
 - 7. Recompacted placement shall be retested at same frequency as first test series, including verification tests.
 - 8. Identify elevation of test with respect to natural ground or pavement.
- F. Recondition, recompact and retest at the Contractor's expense if tests indicate the Work does not meet specified compaction requirements. For

hardened soil cement with nonconforming density, core and test for compressive strength at the Contractor's expense.

- G. Acceptability of crushed rock compaction will be determined by inspection.

3.12 DISPOSAL OF EXCESS MATERIAL

- A. Excess material shall be the property of the Contractor and shall be disposed of properly with no cost to the City. Dispose of excess materials in accordance with requirements of Section 01580 – Waste Material Disposal.

PART IV: TABLES

4.1 TABLE EXCAVATION WIDTHS

Nominal Pipe Size, inches	Minimum Trench Width, inches
Less than 18"	O.D. + 18"
18" to 30"	O.D. + 24"
36" to 42"	O.D. + 36"
Greater than 42"	O.D. + 48"

END OF SECTION

**SECTION 02130
EXTRA UNIT PRICE WORK FOR EXCAVATION AND BACKFILL**

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Measurement and payment applicable to extra unit price work items for excavation and backfill made necessary by unusual or unforeseen circumstances encountered during utility installations.
- B. Extra unit price work for excavation and backfill shall be paid only when authorized in advance by the Project Manager.

1.2 UNIT PRICES:

- A. Extra Excavation Around Obstructions: Payment for excavation around obstructions shall be on a cubic yard basis, measured in place, without deduction for volume occupied by portions of pipes, ducts, or other structures left in place across trenches excavated under this item.
- B. Extra Hand Excavation: Payment for extra hand excavation shall be on a cubic yard basis, measured in place.
- C. Extra Machine Excavation: Payment for extra machine excavation shall be on a cubic yard basis, measured in place.
- D. Extra Placement of Backfill Material: Payment for extra placement of backfill material shall be on a cubic yard basis, measured in place, for material installed as part of the Work. At discretion of the Project Manager, measurement of cubic yards may be calculated from volume of Extra Hand Excavation or Extra Machine Excavation for which replacement is made, minus volume of any Extra Placement of Granular Backfill authorized in conjunction with the Work.
- E. Extra Placement of Granular Backfill: Payment for extra placement of granular backfill material shall be on a cubic yard basis, measured in place.
- F. No separate payment will be made for surface water control, groundwater control, or for excavation drainage. Refer to Section 01270 – Measurement and Payment for unit price procedures.

1.3 DEFINITIONS

- A. Excavation Around Obstructions: Excavation necessitated by obstruction of pipes (other than service connections three inches (3 in) in diameter or less), ducts, or other structures, not shown on the Drawings, and of an unusual or unforeseen nature which interfere with installation of utility piping by normal methods of excavation or auguring.
- B. Extra Hand Excavation: Excavation by manual labor made necessary by unusual or unforeseen circumstances at locations approved in advance by the Project Manager.
- C. Extra Machine Excavation: Excavation by machine at or near project site

02130-1

to perform related work not included in original project scope but added for convenience of the City, as approved in advance by the Project Manager.

- D. Extra Replacement of Backfill Material: Handling, backfill, and compaction of excavated material authorized under extra work bid items for Extra Hand Excavation or Extra Machine Excavation as approved in advance by the Project Manager. Placement and compaction shall conform to requirements specified for excavation and backfill in Division 2 - Site Work.
- E. Extra Placement of Granular Backfill: Hauling, placing, and compacting granular backfill materials as approved by the Project Manager in conjunction with Extra Replacement of Backfill Material. Materials placed under this item shall conform to requirements for Bank Run Sand, Cement Stabilized Sand, Concrete Sand, Gem Sand, Crushed Stone, or Crushed Concrete specified for backfill material in Division 2 - Site Work.

1.4 REFERENCES

- A. CFTS – City of Friendswood Technical Specifications.

PART II: PRODUCTS – Not Used

PART III: EXECUTION – Not Used

END OF SECTION

SECTION 02140 UTILITY BACKFILL MATERIALS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Material Classifications.
- B. Utility Backfill Materials:
 - 1. Concrete sand.
 - 2. Gem sand.
 - 3. Pea gravel.
 - 4. Crushed stone.
 - 5. Crushed concrete.
 - 6. Bank run sand.
 - 7. Select backfill.
 - 8. Random backfill.
- C. Material Handling and Quality Control Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment will be made for backfill material. Include payment in unit price for applicable utility installation.
 - 2. Payment for backfill material, when included as separate pay item or when directed by the Project Manager, shall be on a cubic yard basis for material placed and compacted within theoretical trench width limits and thickness of material according to the Drawings or as directed by the Project Manager.
 - 3. Payment for backfill of authorized over-excavation is in accordance with Section 02130 – Extra Unit Price Work for Excavation and Backfill.
 - 4. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 DEFINITIONS

- A. Unsuitable Material:
 - 1. Materials classified as ML, CL-ML, MH, PT, OH and OL according to ASTM D2487.
 - 2. Materials that cannot be compacted to required density due to gradation, plasticity or moisture content.
 - 3. Materials containing large clods, aggregates or stones greater than four inches (4 In) in any dimension; debris, vegetation or waste; or any other deleterious materials.

4. Materials contaminated with hydrocarbons or other chemical contaminants.
- B. Suitable Material:
 1. Materials meeting specification requirements.
 2. Unsuitable materials meeting specification requirements for suitable soils after treatment with lime or cement.
- C. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material shall be placed and compacted as backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs as directed by the Project Manager.
- D. Foundation Base: Crushed stone aggregate with filter fabric as required, cement-stabilized sand or concrete seal slab. Foundation base provides smooth, level working surface for construction of concrete foundation.
- E. Backfill Material: Classified soil material meeting specified quality requirements for designated application as embedment or trench zone backfill.
- F. Embedment Material: Soil material placed under controlled conditions within embedment zone extending vertically upward from top of foundation to an elevation twelve inches (12 In) above top of pipe and including pipe bedding, haunching and initial backfill.
- G. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in trench zone from top of embedment zone to base course in paved areas or to surface grading material in unpaved areas.
- H. Foundation: Either suitable soil of trench bottom or material placed as backfill of over-excavation for removal and replacement of unsuitable or otherwise unstable soils.
- I. Source: Source selected by the Contractor for supply of embedment or trench zone backfill material. Selected source may be project excavation, off-site borrow pits, commercial borrow pits or sand and aggregate production or manufacturing plants, subject to approval by the Project Manager.
- J. Refer to Section 02125 – Excavation and Backfill for Utilities for other definitions regarding utility installation by trench construction.

1.4 REFERENCES

- A. ASTM – American Society for Testing and Materials.
 1. ASTM C33 – Standard Specification for Concrete Aggregate.
 2. ASTM C40 – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
 3. ASTM C123 – Standard Test Method for Lightweight Particles in Aggregate.
 4. ASTM C131 – Standard Test Method for Resistance to

02140-2

- Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in Los Angeles Machine.
- 5. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- 6. ASTM C142 – Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
- 7. ASTM D1140 – Standard Test Method for Amount of Material in Soils Finer Than No. 200 Sieve.
- 8. ASTM D2487 – Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- 9. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- 10. ASTM D4643 – Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method.
- B. CFTS – City of Friendswood Technical Specifications.
- C. TxDOT – Texas Department of Transportation.
 - 1. TxDOT Tex-110-E – Determining Particle Size Analysis of Soils.
 - 2. TxDOT Tex-460-A – Material Finer Than 75 Fm (No.200) Sieve In Mineral Aggregates (Decantation Test for Concrete Aggregates).

1.5 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit description of source, material classification and product description, production method and application of backfill materials.
- C. Submit test results for samples of off-site backfill materials. Comply with Paragraph 2.3, Material Testing.
- D. Before stockpiling materials, submit copy of approval from landowner for stockpiling backfill material on a private property.
- E. Provide delivery ticket which includes source location for each delivery of material that is obtained from off-site sources or is being paid as a specific bid item.

1.6 TESTS

- A. Perform tests of sources for backfill material in accordance with Paragraph 2.3.B.
- B. Verification tests of backfill materials shall be performed by the City in accordance with Sections 01470 – Testing Laboratory Services and 01475 – Quality Control Testing Procedures and in accordance with Paragraph 3.3.

1.7 EMBEDEMENT

- A. Gravity Sanitary Sewers and Storm sewers shall use Cement-Stabilized Sand for bedding, haunching and initial backfill.
- B. Water lines and Force Main Sewers shall use Bank run sand for bedding, haunching and initial backfill.

PART II: PRODUCTS

2.1 MATERIAL CLASSIFICATIONS

- A. Classify materials for backfill for purpose of quality control in accordance with Unified Soil Classification Symbols as defined in ASTM D2487. Material use and application is defined in utility installation specifications and the Drawings either by class, as described in Paragraph 2.1.B or by product descriptions, as given in Paragraph 2.2.
- B. Class Designations Based on Laboratory Testing:
 - 1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):
 - a. Plasticity index: Non-plastic.
 - b. Gradation: D_{60}/D_{10} – greater than four percent (4%); amount passing No. 200 sieve – less than or equal to five percent (5%).
 - 2. Class II: Poorly graded gravels and sands, silty gravels and sands, little to moderate fines (GM, GP, SP, SM):
 - a. Plasticity index: Non-plastic to four (4).
 - b. Gradations:
 - 1) Gradation (GP, SP): amount passing No. 200 sieve – less than five percent (5%).
 - 2) Gradation (GM, SM): amount passing No. 200 sieve – between twelve percent (12%) and fifty percent (50%).
 - 3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve – between five percent (5%) and twelve percent (12%).
 - 3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt and clay (GC, SC and dual classifications, e.g., SP-SC):
 - a. Plasticity index: Greater than seven (7).
 - b. Gradation: Amount passing No. 200 sieve – between twelve percent (12%) and fifty percent (50%).
 - 4. Class IVA: Lean clays (CL).
 - a. Plasticity Indexes:
 - 1) Plasticity index: Greater than seven (7) and above A line.
 - 2) Borderline plasticity with dual classifications (CL-ML): PI between four (4) and seven (7).
 - b. Liquid limit: Less than fifty (50).
 - c. Gradation: Amount passing No. 200 sieve – greater than fifty percent (50%).
 - d. Inorganic.
 - 5. Class IVB: Fat clays (CH).

- a. Plasticity index: Above A line.
 - b. Liquid limit: Fifty (50) or greater.
 - c. Gradation: Amount passing No. 200 sieve – greater than fifty percent (50%).
 - d. Inorganic.
6. Use soils with dual class designation according to ASTM D2487 and which are not defined above, according to more restrictive class.

2.2 PRODUCT DESCRIPTIONS

- A. Soils classified as silt (ML) silty clay (CL-ML with PI of four (4) to seven (7), elastic silt (MH), organic clay and organic silt (OL, OH) and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by the Project Manager. Soils in Class IVC, fat clay (CH) may be used as backfill materials where allowed by applicable backfill installation specification. Refer to Section 02120 – Excavation and Backfill for Structures and Section 02125 – Excavation and Backfill for Utilities.
- B. Provide backfill material that is free of stones greater than six inches (6 in), free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to following limits for deleterious materials:
 1. Clay lumps: Less than one-half percent (1/2%) for Class I and less than two percent (2%) for Class II, when tested in accordance with ASTM C142.
 2. Lightweight pieces: Less than five percent (5%) when tested in accordance with ASTM C123.
 3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C40.
- C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in product specification and as approved by the Project Manager, provided that physical property criteria are determined to be satisfactory by testing.
- D. Bank Run Sand: Durable bank run sand classified as SP, SW or SM by Unified Soil Classification System (ASTM D2487) meeting following requirements:
 1. Less than fifteen percent (15%) passing No. 200 sieve when tested in accordance with ASTM D1140. Amount of clay lumps or balls may not exceed two percent (2%).
 2. Material passing No. 40 sieve shall meet the following requirements when tested in accordance with ASTM D4318: Plasticity index: not exceeding seven (7).
- E. Concrete Sand: Natural sand, manufactured sand or combination of natural and manufactured sand conforming to requirements of ASTM C33 and graded within limits specified in Table 4.1 – SIEVE ANALYSIS REQUIREMENTS FOR CONCRETE SAND in this section, when tested

- in accordance with ASTM C136.
- F. Gem Sand: Sand conforming to requirements of ASTM C33 for course aggregates specified for No. 8 size and graded within the limits specified in Table 4.2 – SIEVE ANALYSIS REQUIREMENTS FOR GEM SAND in this section, when tested in accordance with ASTM C136.
 - G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the limits specified in Table 4.3 – SIEVE ANALYSIS REQUIREMENTS FOR PEA GRAVEL in this section, when tested in accordance with ASTM C136.
 - H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:
 - 1. Materials of one (1) product delivered for same construction activity from single source, unless otherwise approved by the Project Manager.
 - 2. Non-plastic fines.
 - 3. Los Angeles abrasion test wear not exceeding forty-five percent (45%) when tested in accordance with ASTM C131.
 - 4. Crushed aggregate shall have minimum of ninety percent (90%) of particles retained on a No. 4 sieve with two (2) or more crushed faces as determined by Tex-460-A, Part I.
 - 5. Crushed stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from naturally occurring single source. Uncrushed gravel is not acceptable materials for embedment where crushed stone is shown on applicable utility embedment drawing details.
 - 6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, reinforcing steel fragments, soil, waste gypsum (calcium sulfate) or debris.
 - 7. Gradations, as determined in Table 4.4 – SIEVE ANALYSIS REQUIREMENTS FOR CRUSHED AGGREGATE in this section, in accordance with Tex-110-E.
 - I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with plasticity index between seven (7) and twenty (20) or clayey soils treated with lime in accordance with Section 02845 – Pavement Repair and Resurfacing, to meet plasticity criteria.
 - J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by applicable backfill installation specification. Refer to Section 02120 – Excavation and Backfill for Structures and Section 02125 – Excavation and Backfill for Utilities.
 - K. Cement-Stabilized Sand: Conform to requirements of Section 02145 – Cement-Stabilized Sand.

- L. Concrete Backfill: Conform to Class A concrete as specified in Section 03300 – Structural Concrete.
- M. Flexible Base Course Material: Conform to requirements of applicable portions of Section 02700 – Cement-Stabilized Base Course, Section 02705 – Crushed Concrete Base Course and Section 02715 – Hot-Mix Asphaltic Base Course.

2.3 MATERIAL TESTING

- A. Source Qualification: Perform testing to obtain tests by suppliers for selection of material sources and products not from the project site. Test samples of processed materials from current production representing material to be delivered. Use tests to verify that materials meet specification requirements. Repeat qualification test procedures each time source characteristics change or there is planned change in source location or supplier. Include the following qualification tests, as applicable:
 - 1. Gradation: Report complete sieve analyses regardless of specified control sieves from largest particle through No. 200 sieve.
 - 2. Plasticity of material passing No. 40 sieve.
 - 3. Los Angeles abrasion wear of material retained on a No. 4 sieve.
 - 4. Clay lumps.
 - 5. Lightweight pieces.
 - 6. Organic impurities.
- B. Production Testing: Provide reports to the Project Manager from an independent testing laboratory that backfill materials to be placed in the Work meet applicable specification requirements.
- C. Assist the Project Manager in obtaining material samples for verification testing at source or at production plant.

PART III: EXECUTION

3.1 SOURCES

- A. Use of existing material in trench excavations is acceptable, provided applicable Technical Specification requirements are satisfied.
- B. Identify off-site sources for backfill materials at least fourteen days (14 D) ahead of intended use so that the Project Manager may obtain samples for verification testing.
- C. Materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet requirements of specifications shall be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials or by contamination. Once material is approved by the Project Manager, expense for sampling and testing required to change to different material shall be arranged and paid for by the Contractor.

- D. Bank run sand, select backfill and random backfill, if available in project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete work from off-site sources.
- E. The City does not represent or guarantee that any soil found in excavation work will be suitable and acceptable as backfill material.

3.2 MATERIAL HANDLING

- A. When backfill material is obtained from either commercial or non-commercial borrow pit, open pit to expose vertical faces of various strata for identification and selection of approved material to be used. Excavate selected material by vertical cuts extending through exposed strata to achieve uniformity in product.
- B. Establish temporary stockpile locations for practical material handling, control and verification testing by the Project Manager in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.
- C. When stockpiling backfill material near project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering drainage system.
- D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

3.3 FIELD QUALITY CONTROL

- A. Quality Control.
 - 1. The Project Manager may sample and test backfill at:
 - a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.
 - b. On-site stockpiles.
 - c. Materials placed in the Work.
 - 2. The Project Manager may re-sample material at any stage of work or location if changes in characteristics are apparent.
- B. Production Verification Testing: A Certified testing laboratory as described in Section 01470 – Testing Laboratory Services, will provide verification testing on backfill materials, as directed by the Project Manager. Samples may be taken at source or at production plant, as applicable.

PART IV: TABLES

4.1 SIEVE ANALYSIS REQUIREMENTS FOR CONCRETE SAND

Sieve	Percent Passing
3/8"	100%
No. 4	95% to 100%
No. 8	80% to 100%
No. 16	50% to 85%
No. 30	25% to 60%
No. 50	10% to 30%
No. 100	2% to 10%

4.2 SIEVE ANALYSIS REQUIREMENTS FOR GEM SAND

Sieve	Percent Passing
3/8"	95% to 100%
No. 4	60% to 80%
No. 8	15% to 40%

4.3 SIEVE ANALYSIS REQUIREMENTS FOR PEA GRAVEL

Sieve	Percent Passing
1/2"	100%
3/8"	85% to 100%
No. 4	10% to 30%
No. 8	0% to 10%
No. 16	0% to 5%

4.4 SIEVE ANALYSIS REQUIREMENTS FOR CRUSHED AGGREGATES

Sieve	Percent Passing by Weight for Pipe Embedment by Ranges of Nominal Pipe Sizes		
	>15"	15" to 8"	<8"
1"	95% to 100%	100%	- -
3/4"	60% to 90%	90% to 100%	100%
1/2"	25% to 60%	- -	90% to 100%
3/8"	- -	20% to 55%	40% to 70%
No. 4	0% to 5%	0% to 10%	0% to 15%
No. 8	- -	0% to 5%	0% to 5%

END OF SECTION

SECTION 02145 CEMENT-STABILIZED SAND

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Cement-stabilized sand.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:

1. No separate payment will be made for work performed under this Section. Include cost of such work in Contract unit prices for items listed in Unit Price Form requiring cement-stabilized sand.
2. Refer to Section 01270 – Measurement and Payment for unit price procedures.

- B. Stipulated Price (Lump Sum):

1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 REFERENCES

- A. ASTM – American Society for Testing and Materials.

1. ASTM C33 – Standard Specification for Concrete Aggregates (Fine Aggregate).
2. ASTM C40 – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
3. ASTM C42 – Standard Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
4. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
5. ASTM C123 – Standard Test Method for Lightweight Particles in Aggregate.
6. ASTM C142 – Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
7. ASTM C150 – Specification for Portland Cement.
8. ASTM D558 – Standard Test Method for Moisture-Density Relations of Soil Cement-Mixtures.
9. ASTM D1632 – Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory.
10. ASTM D1633 – Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders.
11. ASTM D2487 – Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
12. ASTM D2922 – Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
13. ASTM D3665 – Standard Practice for Random Sampling of

02145-1

- Construction Materials.
- 14. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- B. CFTS – City of Friendswood Technical Specifications.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit proposed target cement content and production data for sand-cement mixture in accordance with requirements of Paragraph 2.3, Materials Qualifications.

1.5 DESIGN REQUIREMENTS

- A. Use sand-cement mixture producing minimum unconfined compressive strength of one hundred (100 psi) in forty-eight hours (48 Hrs).
 - 1. Design will be based on strength specimens molded in accordance with ASTM D558 at moisture content within three percent (3%) above or below of optimum moisture content and within four hours (4 Hrs) of batching.
 - 2. Determine minimum cement content from production data and statistical history. Provide no less than one and one tenth (1.1) sacks of cement per ton of dry sand.

PART II: PRODUCTS

2.1 MATERIALS

- A. Cement: Type I Portland cement conforming to ASTM C150.
- B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C33 or requirements for bank run sand of Section 02140 – Utility Backfill Materials and the following requirements:
 - 1. Classified as SW, SP, SW-SM, SP-SM or SM by Unified Soil Classification System of ASTM D2487.
 - 2. Deleterious materials:
 - a. Clay lumps, ASTM C142 – less than one-half percent (1/2%).
 - b. Lightweight pieces, ASTM C123; less than five percent (5%).
 - c. Organic impurities, ASTM C40, color no darker than standard color.
 - 3. Plasticity index of four (4) or less when tested in accordance with ASTM D4318.
- C. Water: Potable water, free of oils, acids, alkalies, organic matter or other deleterious substances, meeting requirements of ASTM C94.

2.2 MIXING MATERIALS

- A. Add required amount of water and mix thoroughly in pugmill-type mixer.

- B. Stamp batch ticket at plant with time of loading. Reject material not placed and compacted within four hours (4 Hrs) after mixing.

2.3 MATERIAL QUALIFICATION

- A. Determine target cement content of material as follows:
 - 1. Obtain samples of sand-cement mixtures at production facility representing range of cement content consisting of at least three (3) points.
 - 2. Complete molding of samples within four hours (4 Hrs) after addition of water.
 - 3. Perform strength tests [average of two (2) specimens] at forty-eight hours (48 Hrs) and seven days (7 D).
 - 4. Perform cement content tests on each sample.
 - 5. Perform moisture content tests on each sample.
 - 6. Plot average forty-eight hour (48 Hr) strength vs. cement content.
 - 7. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings and silo pressure (if applicable).
- B. Test raw sand for following properties at point of entry into pug-mill:
 - 1. Gradation.
 - 2. Plasticity index.
 - 3. Organic impurities.
 - 4. Clay lumps and friable particles.
 - 5. Lightweight pieces.
 - 6. Moisture content.
 - 7. Classification.
- C. Present data obtained in format similar to that provided in sample data form attached to this Section.

PART III: EXECUTION

3.1 PLACING

- A. Place sand-cement mixture in maximum twelve inch (12 In) thick loose lifts and compact to ninety-five percent (95%) of maximum density as determined in accordance with ASTM D558, unless otherwise specified. Refer to related specifications for thickness of lifts in other applications. Target moisture content during compaction is plus or minus three percent ($\pm 3\%$) of optimum moisture content. Perform and complete compaction of sand-cement mixture within four hours (4 Hrs) after addition of water to mix at plant.
- B. Do not place or compact sand-cement mixture in standing or free water.

3.2 FIELD QUALITY CONTROL

- A. Testing shall be performed under provisions of Sections 01470 – Testing Laboratory Services and 01475 – Quality Control Testing Procedures.
- B. One (1) sample of cement-stabilized sand shall be obtained for each one hundred fifty tons (150 Tn) of material placed per day with no less than one (1) sample per day of production. Random samples of delivered cement-stabilized sand shall be taken in the field at point of delivery in accordance with ASTM D3665. Obtain three (3) individual samples of approximately twelve pounds (12 Lbs.) to fifteen pounds (15 Lbs.) each from the first (1st), middle and last third (3rd) of the truck and composite them into one sample for test purpose.
- C. Prepare and mold four (4) specimens (for each sample obtained) in accordance with ASTM D558, Method A, without adjusting moisture content. Samples shall be molded at approximately same time material is being used, but no later than four hours (4 Hrs) after water is added to mix.
- D. After molding, specimens shall be removed from molds and cured in accordance with ASTM D1632.
- E. Specimens shall be tested for compressive strength in accordance with ASTM D1633, Method A. Two (2) specimens shall be tested at forty-eight hours (48 Hrs) plus or minus two hours (± 2 Hrs) and two (2) specimens shall be tested at seven days (7 D) plus or minus four hours (± 4 Hrs).
- F. A strength test shall be the average of strengths of two (2) specimens molded from the same sample of material and tested at the same age. The average daily strength shall be the average of strengths of all specimens molded during one day's (1 D) production and tested at same the age.
- G. Precision and Bias: Test results shall meet recommended guideline for precision in ASTM D1633 Section 9.
- H. Reporting: Test reports shall contain, as a minimum, as specified in TABLE 4.1 – CEMENT-STABILIZED SAND REPORT in this section, the following information:
 - 1. Supplier and plant number.
 - 2. Time material was batched.
 - 3. Time material was sampled.
 - 4. Test age (exact hours).
 - 5. Average forty-eight hour (48 Hr) strength.
 - 6. Average seven day (7 D) strength.
 - 7. Technical Specification section number.
 - 8. Indication of compliance / non-compliance.
 - 9. Mixture identification.
 - 10. Truck and ticket numbers.
 - 11. The time of molding.
 - 12. Moisture content at time of molding.
 - 13. Required strength.

14. Test method designations.
15. Compressive strength data as required by ASTM D1633.
16. Supplier mixture identification.
17. Specimen diameter and height, in.
18. Specimen cross-sectional area, sq.in.

3.3 ACCEPTANCE

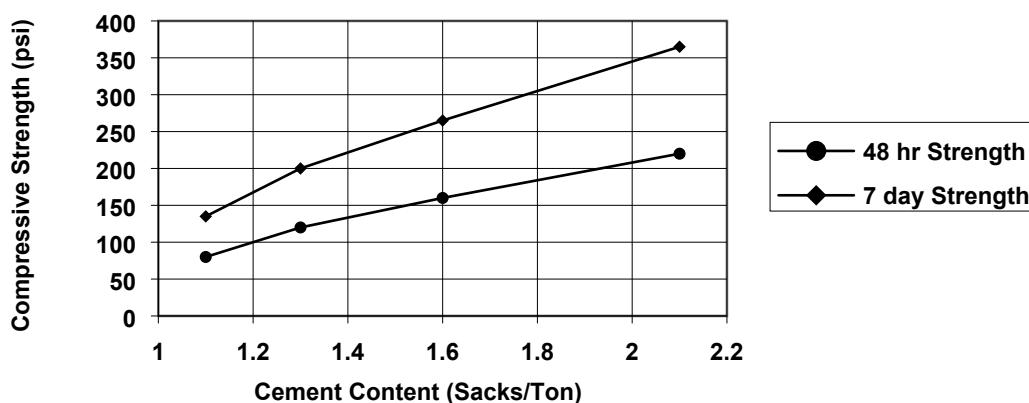
- A. Strength level of material shall be considered satisfactory if:
 1. The average forty-eight hour (48 Hr) strength is greater than one hundred pounds per square inch (100 psi) with no individual strength test below seventy pounds per square inch (70 psi).
 2. All seven day (7 D) individual strength tests [average of two (2) specimens] are greater than or equal to one hundred pounds per square inch (100 psi).
- B. The material shall be considered unacceptable and subject to removal and replacement at the Contractor's expense when individual strength test [average of two (2) specimens] has seven day (7 D) strength] less than one hundred pounds per square inch (100 psi).
- C. When the moving average of three (3) daily forty-eight hour (48 Hr) averages falls below one hundred pounds per square inch (100 psi), discontinue shipment to project until plant is capable of producing material, which exceeds one hundred pounds per square inch (100 psi) at forty hours (48 Hrs). Five (5) – forty eight hour (48 Hr) strength tests shall be made in this determination with no individual strength tests less than one hundred one hundred pounds per square inch (100 psi).
- D. The Testing laboratory shall notify the Contractor, the Project Manager and the material supplier of tests by facsimile indicating results falling below specified strength requirements within twenty-four hours (24 Hrs).
- E. If any strength test of laboratory cured specimens falls below the specified strength, the Contractor may, at his own expense, request testing of cores drilled from the area(s) in question in accordance with ASTM C42. In such cases, three (3) cores shall be taken for each strength test that falls below the values given in paragraph 3.3.A.
- F. Cement-stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least one hundred pounds per square inch (100 psi). Additional testing of cores extracted from locations represented by erratic core strength results shall be permitted.

PART IV: TABLES

4.1 CEMENT-STABILIZED SAND REPORT

Supplier: Stabilized Sand Co.		Plant No.: 3 – Friendswood		Date of Tests: June 3, 2005	
Item	Raw Sand	1.1 Sack	100 psi	1.5 Sack	2.0 Sack
Moisture Content	10.9	15.7	14.0	13.8	13.7
Cement Feed Dial Setting	--	2.25	2.5	2.75	3.75
Silo Pressure (psi)	--	4	4	4	4
Batch Time	10:00	10:10	10:15	10:20	10:25
Sample Time	--	10:10	10:15	10:20	10:25
Molding Time	--	12:30	12:45	1:00	1:15
Cement Content (sacks/ton)	--	1.1	1.3	1.6	2.1
Compressive Strength as 48 hrs (avg of 2)	--	80	120	160	220
Compressive Strength at 7 days (avg of 2)	--	135	200	265	365
Sieve Size	Percent Passing		COF Spec. Section 02140		
3/8 Inch	100%		100%		
No. 200	30%		30%		
Raw Sand Tests	Result		City of Friendswood		
Plasticity Index	Non-Plastic		4 Maximum		
Organic Impurities	Passing		No Darker Than		
Clay Lumps & Friable Parts (%)	0.0		0.5 % Maximum		
Lightweight Pieces (%)	0.0		5.0 % Maximum		
Classification	SP – SM		SW, SP, SW-SM, SP-SM, SM		

**Compressive Strength vs Cement
Content**



**END OF SECTION
02145-6**

SECTION 02215 DUCTILE IRON PIPE (DIP) AND FITTINGS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Ductile Iron Pipe (DIP) and fittings for water lines, wastewater force mains, gravity sanitary sewers and storm sewers.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment will be made for Ductile Iron Pipe (DIP) and fittings under this Section, with the exception of extra fittings in place. Include cost in unit prices for work as specified in the following Sections, as applicable:
 - a. Section 02400 – Water Lines.
 - b. Section 02500 – Gravity Sanitary Sewers.
 - c. Section 02510 – Sanitary Sewer Force Mains.
 - d. Section 02600 – Storm Sewers.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Extra Ductile Iron Pipe (DIP) Compact Fittings in Place shall be for additional fittings required to complete job. This is not to exclude extension of pipe across driveway or intersection for purpose of terminating line in more advantageous position. This determination shall be at discretion of the Project Manager. This bid item includes additional fittings as may be necessary to complete job in conformance with intent of the Drawings.
- C. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 REFERENCES

- A. AASHTO – American Association of State Highway and Transportation Officials.
- B. AREMA – American Railway Engineering and Maintenance-of-Way Association.
 - 1. Manual for Railway Engineering.
- C. ANSI – American National Standards Institute.
 - 1. ANSI A21.4 (AWWA C104) – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings, for Water.
 - 2. ANSI A21.10 (AWWA C110) – Standard for Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in.
 - 3. ANSI A21.11 (AWWA C111) – Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

4. ANSI A21.15 (AWWA C115) – Standard for Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.
5. ANSI A21.16 (AWWA C116) – Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey iron Fittings for Water Supply Service.
6. ANSI A21.50 (AWWA C150) – Standard for Thickness Design of Ductile-Iron Pipe.
7. ANSI A21.51 (AWWA C151) – Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids.
8. ANSI A21.53 (AWWA C153) – Standard for Ductile Iron Compact Fittings, 3 inches through 24 inches and 54 inches through 64 inches for Water Service.
- D. ASME – American Society of Mechanical Engineers.
 1. ASME B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.
- E. ASTM – American Society for Testing and Materials.
 1. ASTM D1248 – Standard Specification Polyethylene Plastics Molding and Extrusion Materials for Wire and Cable.
 2. ASTM F477 – Elastomeric Seals (gaskets) for Joining Plastic Pipe.
 3. ASTM G62 – Standard Test Methods for Holiday Detection in Pipeline Coatings.
- F. AWWA – American Water Works Association.
 1. AWWA C102 – American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 2. AWWA C300 – Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and other Liquids.
 3. AWWA C600 – Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.
- G. CFTS – City of Friendswood Technical Specifications.
- H. SSPC – Steel Structures Painting Council.
 1. SSPC-SP 6 – Steel Structures Painting Council, Commercial Blast Cleaning.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. For pipes sixteen inches (16 In) and greater submit shop drawings signed and sealed by a Professional Engineer registered in the State of Texas showing the following:
 1. Manufacturer's pipe design calculations
 2. Lay schedule of pictorial nature indicating alignment and grade, laying dimensions, fitting, flange and special details, with plan view of each pipe segment sketched, detailing pipe invert elevations, horizontal bends, restrained joints and other critical features. Indicate station numbers for pipe and fittings corresponding to the Drawings. Do not start production of pipe and fittings prior to review and approval by the Project Manager.

- Provide final approved lay schedule on CD-ROM in Adobe portable document format (*.PDF).
- 3. Calculations and limits of thrust restraint
- 4. Class and length of joint
- C. Submit manufacturer's certifications that Ductile Iron Pipe (DIP) and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A21.51.
- D. Submit certifications that pipe joints have been tested and meet requirements of ANSI A21.11.
- E. Submit affidavit of compliance in accordance with ANSI A21.16 for fittings with fusion bonded epoxy coatings or linings.

1.5 QUALITY ASSURANCE

- A. Provide manufacturer's affidavits that pipe was manufactured in compliance with standards referenced in this Section.

PART II: PRODUCTS

2.1 DUCTILE IRON PIPE (DIP)

- A. Ductile Iron Pipe (DIP) Barrels: ANSI A21.15, ANSI A21.50 or ANSI A21.51; bear mark of Underwriters' Laboratories approval; minimum thickness Class 51 for water lines and thickness Class 52 for sanitary sewers or as shown on the Drawings. Provide minimum thickness Class 53 for flanged pipe.
- B. Provide pipe sections in standard lengths, not less than eighteen feet (18 Ft) long, except for special fittings and closure sections as indicated on shop drawings.
- C. Modify pipe for cathodic protection in accordance with Section 02285 – Cathodic Protection. In lieu of furnishing Ductile Iron Pipe (DIP) with cathodic protection system, furnish Ductile Iron Pipe (DIP) with polyethylene encasement, provided the following criteria is met:
 - 1. Provide minimum thickness class
 - 2. Provide polyethylene encasement material and installation in accordance with AWWA C105 and backfill as specified. Minimum of two (2) complete wraps of eight (8) mil thick polyethylene.
 - 3. Use polyethylene encasement for open cut installations only. For augered sections or sections installed inside a casing, provide coating in accordance with paragraph 2.5.D.1.
 - 4. Adhere to other requirements specified herein (e.g., insulation kits, etc.).
- D. For use of pressure class pipe for water lines, design pipe and fittings to withstand most critical simultaneous application of external loads and internal pressures. Base design on minimum of AASHTO HS-20 loading, AREMA E-80 loads and depths of bury as indicated on the Drawings.

Design pipes with Marston's earth loads for a transition width trench for zero feet (0 Ft) to sixteen feet (16 Ft) of cover. Use Marston's earth loads for a trench width of O.D. (of pipe) plus four feet (+4 Ft) for pipe greater than sixteen feet (16 Ft) of cover. Use Marston's equations for a trench condition in both open-cut and tunnel applications. Design for most critical groundwater level condition. Pipe design conditions:

1. Working pressure = One hundred pounds per square inch (100 psi).
 2. Hydrostatic field test pressure = One hundred fifty pounds per square inch (150 psi).
 3. Maximum pressure due to surge = One hundred fifty pounds per square inch (150 psi).
 4. Minimum Pressure due to surge = Minus five pounds per square inch (-5 psi).
 5. Design tensile stress due to surge or hydrostatic test pressure: No greater than fifty percent (50%) minimum yield.
 6. Design bending stress due to combined earth loads and surge or hydrostatic test pressure: No greater than forty-eight thousand pounds per square inch (48,000 psi).
 7. Unit weight of fill $\geq$ One hundred twenty pounds per cubic foot (120 pcf).
 8. Deflection lag factor (D_l) = One and two tenths (1.2).
 9. Bedding constant (K) = One tenth (0.1).
 10. Moment coefficient = Sixteen hundredths (0.16).
 11. Fully saturated soil conditions $h_w = h =$ depth of cover above top of pipe.
- E. Hydrostatic Test of Pipe: AWWA C151, Section 5.2.1, at point of manufacture. Hold test for a minimum two minutes (2 Min) for thorough inspection of pipe. Repair or reject pipe revealing leaks or cracks.
- F. Pipe Manufacturer for large diameter water lines: Minimum of five years (5 Yrs) of successful pipe installations in continuous service. Manufacturer must maintain on site or in plant enough fittings to satisfy the requirements as specified in TABLE 4.1 – REQUIRED BENDS in this Section.
- Manufacturer or supplier must be capable of delivering bends to job site within twelve hours (12 Hrs) of notification. Use fittings at direction of the Project Manager where unforeseen obstacles are encountered during construction. These fittings are in addition to any fittings called out in construction documents and must be available at all times.
- G. Provide flange adapter with insulating kit as required when connecting new piping to existing piping and piping of different materials, unless otherwise approved by the Project Manager.
- H. Clearly mark pipe section to show location and thickness/pressure class color coded.

2.2 JOINTS

- A. Joint Types: ANSI A21.11 push-on; ANSI A21.11 mechanical joint; or ANSI A21.16 flanged end. Provide push-on joints unless otherwise indicated on the Drawings or required by these specifications. For bolted joints, conform to requirements of AWWA C111; provide minimum 304 stainless steel for restraint joints.
- B. Where required by the Drawings, provide approved restrained joints for buried service.
- C. Threaded or grooved-type joints which reduce pipe wall thickness below minimum required are not acceptable.
- D. Provide for restrained joints designed to meet test pressures required under Section 02450 – Hydrostatic Testing of Waterlines or Section 02510 – Sanitary Sewer Force Mains, as applicable. Provide restrained joints for test pressure or maximum surge pressure as specified, whichever is greater for water lines. Do not use passive resistance of soil in determining minimum restraint lengths.
- E. Bond rubber gasketed joints to provide electrical continuity along entire pipeline, except where insulating flanges are required by the Drawings.
- F. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer for pipe joints or restraint joints. Submit details of other methods of providing curves and bends for consideration by the Project Manager. When other methods are deemed satisfactory, install at no additional cost to the City.

2.3 GASKETS

- A. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material in accordance with ANSI A21.11 or ASTM F477 (One Bolt only); for flanged joints one-eighth inch (1/8 In) thick gasket in accordance with ANSI A21.15.

2.4 FITTINGS

- A. Use fittings of same size as pipe. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they connect to.
- B. Push-on Fittings: ANSI A21.10; Ductile Iron Pipe (DIP) ANSI A21.11 joints, gaskets and lubricants; pressure rated at two hundred pounds per square inch (250 psi).
- C. Flanged Fittings: ANSI A21.10; Ductile Iron Pipe (DIP) ANSI A21.11 joints, gaskets and lubricants; pressure rated at two hundred fifty pounds per square inch (250 psi).
- D. Mechanical Joint Fittings: ANSI A21.11; pressure rated at two hundred fifty pounds per square inch (250 psi).
- E. Ductile Iron Pipe (DIP) Compact Fittings for Water lines: ANSI A21.53; four inch (4 In) through twelve inch (12 In) diameter fusion bonded epoxy-lined or cement mortar lining.

2.5 COATINGS AND LININGS

- A. Water line Interiors: ANSI A21.4, cement lined with seal coat; ANSI A21.16 fusion bonded epoxy coating for interior; comply with NSF 61.
- B. Sanitary Sewer and Force Main Interiors:
 - 1. Preparation: Commercial blast cleaning conforming to SSPC-SP6.
 - 2. Liner thickness: Nominal forty (40) mils, for pipe barrel interior; minimum six (6) mils to ten (10) mils at gasket groove and outside spigot end to six inches (6 In) back from end.
 - 3. Testing: ASTM G62, Method B for voids and holidays; provide written certification.
 - 4. Acceptable Lining Materials:
 - a. Provide approved virgin polyethylene conforming to ASTM D1248, with inert fillers and carbon black to resist ultraviolet degradation during storage; heat bonded to interior surface of pipe and fittings.
 - b. Ceramic Epoxy – Protecto 401
- C. Sanitary Sewer Point Repair Pipe: For pipes which will be lined with high density polyethylene liner pipe or cured-in-place liner, provide cement-lined with seal coat in accordance with ANSI A21.4. For pipes which will not be provided with named liner, provide pipe as specified in Paragraph 2.5.B.4, Sanitary Sewer and Force Main Interiors.
- D. Exterior:
 - 1. Water Lines:
 - a. Auger Holes: Conform to requirements of Section 02265 – Polyurethane Coatings on Steel or Ductile Iron Pipe.
 - b. Above Ground (or Exposed): Conform to requirements of Section 02250 – Steel Pipe and Fittings, Paragraph 2.3.
 - c. Tunnel, Casing or Direct Bury: Conform to requirements of Paragraph 2.5.E.
 - 2. Sanitary Sewers: Prime coat and outside asphaltic coating conforming to ANSI A21.10, ANSI A21.15 or ANSI A21.51 for pipe and fittings in open cut excavation and in casings.
- E. Polyethylene Wrap: For buried pipes not cathodically protected, provide polyethylene wrap unless otherwise specified or shown. Conform to requirements of Section 02260 – Polyethylene Wrap.
- F. For flanged joints in buried service, provide petrolatum wrapping system, Denso or equal, for the complete joint and alloy steel fasteners. Alternatively, provide bolts made of Type 304 stainless steel.
- G. Pipe to be installed in potentially contaminated areas shall have coatings and linings recommended by the manufacturer for maximum resistance to the contaminants identified in the Phase II Environmental Site Assessment Report.
- H. For water lines cathodically protected, supply Ductile Iron Pipe (DIP) with

either tape coatings or some other bonded dielectric coating as specified in Section 02255 – Steel Pipe and Fittings for Large Diameter Water Lines.

PART III: EXECUTION

3.1 INSTALLATION

- A. Conform to installation requirements of Sections 02400 – Water Lines, 02500 – Gravity Sanitary Sewers, 02510 – Sanitary Sewer Force Mains 02600 – Storm Sewers, 02540 – Sanitary Sewer Point Repairs and 02560 – Sanitary Sewer Obstruction Removal, except as modified in this Section.
- B. Install in accordance with AWWA C600 and manufacturer's recommendations.
- C. Install all Ductile Iron Pipe (DIP) in double polyethylene wrap, unless cathodic protection is provided. Do not use polyethylene wrap with a cathodic protection system.
- D. Holiday Testing:
 - 1. Polyurethane: Conform to requirements of Section 02265 – Polyurethane Coatings for Steel or Ductile Iron Pipe.
 - 2. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

3.2 FIELD REPAIR OF COATINGS

- A. Polyurethane: Conform to requirements of Section 02265 – Polyurethane Coatings for Steel or Ductile Iron Pipe.
- B. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

PART IV: TABLES

4.1 – REQUIRED BENDS

Line Diameter	Required Bends*
20 and 24 inches	Four 45° bends per 5,000 LF of water line
> 24 inches	Four 22.5° bends per 10,000 LF of water line

*Based on total length of contract [minimum of four (4)]. Any combination of bends may be substituted at manufacturer's option [i.e. two (2) – twenty-two and one half degree (22.5°) bends are equivalent to one (1) – forty-five degree (45°) bend] and shall be counted as one (1) fitting.

END OF SECTION

SECTION 02220 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. High density polyethylene (HDPE) pipe for gravity sewers and drains, including fittings.
- B. High density polyethylene (HDPE) pipe for sanitary sewer force mains, including fittings.
- C. High density polyethylene (HDPE) pipe for storm sewers culverts.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment will be made for HDPE pipe under this Section. Include cost in unit prices for work, as specified in following sections:
 - a. Section 02500 – Gravity Sanitary Sewers.
 - b. Section 02510 – Sanitary Sewer Force Mains.
 - c. Section 02600 – Storm Sewers.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

- A. AASHTO – American Association of State Highway and Transportation Officials.
 - 1. AASHTO M294 – Standard Specification for Corrugated Polyethylene Drainage Pipe, 18"- 48" diameter.
 - 2. AASHTO Section 18 – Soil Thermoplastic Pipe Interaction Systems.
 - 3. AASHTO Section 30 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity Flow Applications.
- B. ASTM – American Society for Testing and Materials.
 - 1. ASTM D618 – Standard Practice for Conditioning Plastics for Testing.
 - 2. ASTM D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 - 3. ASTM D2321 – Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Pipe.
 - 4. ASTM D2657 – Standard Practice for Heat Fusion Joining Polyolefin Pipe and Fittings.

02220-1

5. ASTM D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
 6. ASTM D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
 7. ASTM D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 8. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
 9. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 10. ASTM F714 – Standard Specification for Polyethylene Plastic (PE) Pipe (SDR-PR) Based on Outside Diameter.
 11. ASTM F894 – Standard Specification for Polyethylene (PE) Large-Diameter Profile Wall Sewer and Drain Pipe.
- C. CFTS – City of Friendswood Technical Specifications.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit shop drawings showing design of pipe and fittings, laying dimensions, fabrication, fittings, flanges and special details.

1.5 QUALITY CONTROL

- A. Provide manufacturer's certificate of conformance to Technical Specifications.
- B. Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density and other physical properties.
- C. The Project Manager reserves the right to inspect pipes or witness pipe manufacturing. Inspection shall in no way relieve manufacturer of responsibilities to provide products that comply with applicable standards and these Technical Specifications.
 1. Manufacturer's Notification: Should the Project Manager wish to witness manufacture of specific pipes, manufacturer shall provide the Project Manager with a minimum of three weeks (3 Wks) notice of when and where production of those specific pipes will take place.
 2. Failure to Inspect: Approval of products or tests shall not be implied by the Project Manager's decision not to inspect manufacturing, testing or finished pipes.
- D. Hydrostatic testing of Force Mains and Water Lines using HDPE Pipe shall use testing procedures as outlined in paragraph 3.11 of Section 01475 – Quality Control Testing Procedures.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products

02220-2

specified in this section with documented experience of a minimum five years (5 Yrs) of pipe installations that have been in successful, continuous service for same type of service as the proposed Work.

PART II: PRODUCTS

2.1 GENERAL

- A. For new construction gravity sanitary sewer pipe provide HDPE pipe as specified in TABLE 4.1 SANITARY SEWER FOR DIRECT BURY in this Section.
- B. For rehabilitation of gravity sanitary sewer pipe provide HDPE pipe as follows for new construction as specified in TABLE 4.2 SANITARY SEWER FOR SLIPLINING in this Section.
- C. For Residential Driveway Culverts provide HDPE as follows:
 - 1. N-12 and N-12 HC by Advanced Drainage Systems, Inc. (ADS).
 - 2. Sure-Lok F477 by Hancor, Inc.
- D. Furnish solid wall pipe with plain end construction for heat joining (butt fusion) conforming to ASTM D2657. Utilize controlled temperatures and pressures for joining to produce fused leak-free joint.
- E. Furnish profile-wall gravity sewer pipe with bell-and-spigot end construction conforming to ASTM D3212. Joining shall be accomplished with elastomeric gasket in accordance with manufacturer's recommendations. Use integral bell-and-spigot gasketed joint designed so that when assembled, elastomeric gasket, contained in machined groove on pipe spigot, is compressed radially in pipe bell to form positive seal. Design joint to avoid displacement of gasket when installed in accordance with manufacturer's recommendations.
- F. Furnish solid wall pipe for sanitary sewer force mains with a minimum working pressure rating of one hundred fifty pounds per square inch (150 psi) and with inside diameter equal to or greater than nominal pipe size indicated on the Drawings.
- G. Furnish corrugated polyethylene pipe (CPP) for gravity storm sewer pipe. Joints shall be installed such that connection of pipe sections shall form continuous line free from irregularities in flow line. Suitable joints are:
 - 1. Integral Bell and Spigot: Bell shall overlap a minimum of two (2) corrugations of spigot end when fully engaged.
 - 2. Exterior Bell and Spigot: Bell shall be fully welded to exterior of pipe and overlap spigot end so that flow lines and ends match when fully engaged.
- H. Jointing:
 - 1. Gaskets:
 - a. Meet requirements of ASTM F477. Use gasket molded into circular form or extruded to proper section and then spliced into circular form. When no contaminant is identified, use gaskets of properly cured, high-grade

elastomeric compound. Basic polymer shall be natural rubber, synthetic elastomer or blend of both.

- b. Pipes allowed to be installed in potentially contaminated areas, where free product is found near elevation of proposed sewer, shall have gasket materials for noted contaminant as specified in TABLE 4.3 – GASKET MATERIAL REQUIRED FOR CONTAMINANTS in this Section.
2. Lubricant: Use lubricant for assembly of gasketed joints which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

2.2 MATERIALS FOR SANITARY SEWER

- A. Pipe and Fittings: High density, high molecular weight polyethylene pipe material meeting requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D1248. Material meeting requirements of cell classification in accordance with ASTM D3350 are also suitable for making pipe products under these specifications.
- B. Other Pipe Materials: Materials other than those specified in Paragraph 2.2.A, Pipe and Fittings, may be used as part of profile construction, e.g., as core tube to support shape of profile during processing, provided that these materials are compatible with base polyethylene material and are completely encapsulated in finished product and in no way compromise performance of pipe products in intended use. Examples of suitable material include polyethylene and polypropylene.

2.3 MATERIALS FOR RESIDENTIAL DRIVEWAY CULVERTS

- A. Pipe and Fittings: High density, high molecular weight polyethylene HDPE virgin compound material meeting requirements of cell class outlined in AASHTO M294, AASHTO MP7 and ASTM D3350.
- B. Types: CPP shall meet one (1) or both of following:
 1. Type S: Outer corrugated wall with smooth inner liner.
 2. Type D: Inner and outer smooth walls braced circumferentially or spirally with projections or ribs.
- C. Lubricant: Use lubricant for assembly of gasketed joints, which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

2.4 TEST METHODS FOR SANITARY SEWER

- A. Conditioning: Conditioning of samples prior to and during tests is subject to approval by the Project Manager. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D618 at seventy-three and four-tenths degrees Fahrenheit (73.4°) plus or minus three and six-tenths degrees Fahrenheit ($\pm 3.6^\circ$ F) and fifty percent (50%) relative humidity plus or minus five percent (5%) relative humidity for not less than forty hours (40 Hrs) prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.

- B. Flattening: Flatten three specimens of pipe, prepared in accordance with Paragraph 2.5.A, in suitable press until internal diameter has been reduced to forty percent (40%) of original inside diameter of pipe. Rate of loading shall be uniform and at two inches (2 In) per minute. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking or separation of pipe walls or bracing profiles.
- C. Joint Tightness: Test for joint tightness in accordance with ASTM D3212, except replace shear load transfer bars and supports with six inch (6 In) wide support blocks that can be either flat or contoured to conform to pipe's outer contour.
- D. Purpose of Tests: Flattening and joint tightness tests are not intended to be routine quality control tests, but rather to qualify pipe to a specified level of performance.

2.5 TEST METHODS FOR RESIDENTIAL DRIVEWAY CULVERTS

- A. Pipe stiffness at five percent (5%) deflection, when determined in accordance with ASTM D2412, shall be as specified in Section 7.4 of AASHTO M294.
- B. Minimum inner wall thickness shall be as specified in Section 7.2.2 of AASHTO M294.

2.6 MARKING

- A. Mark each standard and random length of pipe in compliance with these Technical Specifications with following information:
 - 1. Pipe size.
 - 2. Pipe class.
 - 3. Production code.
 - 4. Material designation.

PART III: EXECUTION

3.1 INSTALLATION

- A. Conform to requirements of following Sections:
 - 1. Section 02500 – Gravity Sanitary Sewers.
 - 2. Section 02510 – Sanitary Sewage Force Mains.
 - 3. Section 02525 – Acceptance Testing of Sanitary Sewers.
 - 4. Section 02600 – Storm Sewers.
- B. Install pipe in accordance with the manufacturers recommended installation procedures.
- C. HDPE pipe is not approved in applications requiring augering of pipe.
- D. Bedding and backfill: Conform to requirements of Section 02125 – Excavation and Backfill for Utilities.

PART IV: TABLES

4.1 SANITARY SEWER FOR DIRECT BURY

INSTALLATION SPEC NO.	GENERIC NAME	TRADE NAME OR MANUFACTURER	ASTM OR AASHTO	SDR (NUMERIC INDEX)	PIPE STIFFNESS (NUMERIC MINIMUM)	SIZE RANGE
02220	Solid Wall Polyethylene (HDPE)	Chevron Plexco Phillips 66 Quail Poly Pipe	ASTM F-714	DR 17 DR 21	115 46	8" – 10" 12" – 48"
02500	Polyethylene Profile Wall	Spirolite	ASTM F-894	n/a	46	18" – 120"

4.2 SANITARY SEWER FOR SLIPLINING

INSTALLATION SPEC NO.	GENERIC NAME	TRADE NAME OR MANUFACTURER	ASTM OR AASHTO	SDR (NUMERIC INDEX)	PIPE STIFFNESS (NUMERIC MINIMUM)	SIZE RANGE
02220	Solid Wall Polyethylene (HDPE)	Chevron Plexco Quail Poly Pipe AmeriFlow (NAPCO) AmeriFlow (KWH)	ASTM F-714	DR 21	46	8" – 48" 3" – 12" 14" – 63"
02500	Polyethylene Profile Wall	Spirolite	ASTM F-894	n/a	46	18" – 120"

4.3 GASKET MATERIAL REQUIRED FOR CONTANIMANTS

CONTAMINANT	GASKET MATERIAL REQUIRED
Petroleum (diesel, gasoline)	Nitrile Rubber
Other Contaminants	As recommended by pipe manufacturer

END OF SECTION

SECTION 02250 STEEL PIPE AND FITTINGS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Steel pipe and fittings for water lines for aerial crossings, aboveground piping and encasement sleeves.
- B. Specifications identify requirements for small-diameter less than or equal to twenty inches (20 In).

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No payment will be made for steel pipe and fittings under this Section. Refer to Section 02400 – Water Lines for measurement and payment.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

- A. AASHTO – American Association of State Highway and Transportation Officials.
 - 1. AASHTO – Standard Specifications for Highway Bridges.
- B. ASME – American Society of Mechanical Engineers.
 - 1. ASME B16.1 – Cast-Iron Pipe Flanges and Flanged Fittings.
- C. ASTM – American Society for Testing and Materials.
 - 1. ASTM A36 – Standard Specification for Carbon Structural Steel.
 - 2. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - 3. ASTM A105 – Standard Specification for Carbon Steel Pipe Forgings for Piping Applications.
 - 4. ASTM A106 – Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - 5. ASTM A135 – Standard Specification for Electric-Resistance-Welded Steel Pipe.
 - 6. ASTM A139 – Standard Specification for Electric-Fusion (ARC) – Welded Steel Pipe (NPS 4 and Over).
 - 7. ASTM A1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 8. ASTM D4541 – Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

02250-1

- D. AWWA – American Water Works Association.
 - 1. AWWA C200 – Standard for Steel Water Pipe 6 in. and Larger.
 - 2. AWWA C206 – Standard for Field Welding of Steel Water Pipe.
 - 3. AWWA C207 – Standard for Steel Pipe Flanges for Waterworks Service – Sizes 4 in. through 144 in.
 - 4. AWWA C210 – Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
 - 5. AWWA M11 – Steel Pipe – A Guide for Design and Installation.
- E. CFTS – City of Friendswood Technical Specifications.
- F. SSPC – Steel Structure Painting Council.
 - 1. SSPC Good Painting Practice, Volume 1.
 - 2. SSPC SP1 – Surface Preparation Specification No. 1 Solvent Cleaning.
 - 3. SSPC SP5 – Joint Surface Preparation Standard White Blast Cleaning.
 - 4. SSPC SP6 – Surface Preparation Specification No. 6 Commercial Blast Cleaning.
 - 5. SSPC SP10 – Surface Preparation Specification No. 10 Near-White Blast Cleaning.
 - 6. SSPC VIS1 – Visual Standard for Abrasive Blast Cleaned Steel.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures. For aerial crossings and above ground piping, include lay schedule of new pipe and fittings indicating alignment and grade, laying dimensions, lining and coating systems, proposed welding procedures, fabrication, fitting, flange and special details. Show station numbers for pipe and fittings corresponding to the Drawings.
- B. Submit manufacturer's certifications that pipe and fittings are new and unused.
- C. Submit manufacturer's certifications that pipe and fittings have been hydrostatically tested at factory in accordance with AWWA C200.
- D. Submit manufacturer's affidavits that coatings and linings comply with applicable requirements of this Section and:
 - 1. Polyurethane coatings were applied in strict accordance with manufacturer's recommendation and allowed to cure at temperature five degrees Fahrenheit (5° F) above dew point.
 - 2. Linings were applied and allowed to cure at temperature above thirty-two degrees Fahrenheit (32° F).
- E. Submit certification from National Association of Corrosion Engineers (NACE) Certified Coatings Inspector, having Level III certification for coatings and linings, that steel pipe furnished on project was properly inspected and any defective coating detected was properly repaired.

1.5 QUALITY CONTROL

- A. Prior to start of work, provide proof of certification of qualification for

02250-2

- welders employed for type of work, procedures and positions involved. Provide welder qualifications in accordance with AWWA C206.
- B. Shop-applied coatings and linings; provide services of an independent coating and lining inspection service or testing laboratory with qualified coating inspectors. Perform inspection by NACE trained inspectors under supervision of NACE Level III Certified Coatings Inspector verifying compliance with same requirements specified in Paragraph 3.2.
 - C. Coatings: Measure temperature and dew point of ambient air before applying coatings. Inspect physical dimensions and overall condition of coatings. Inspect for visible surface defects, thickness and adhesion of coating to surface and between layers.
 - D. Final Inspection:
 - 1. Before shipment, inspect each finished pipe, fitting, special and accessory for markings, metal thickness, coating thickness, lining thickness (if shop applied), joint dimensions and roundness.
 - 2. Inspect for coating placement and defects. Test exterior coating for holidays.
 - a. Inspect linings for thickness, pitting, scarring and adhesion.
 - E. Ensure workmen engaged in manufacturing are qualified and experienced in performance of their specific duties.

PART II: PRODUCTS

2.1 STEEL PIPE

- A. Manufacture pipe with nominal diameter twenty inches (20 In) and less, but more than two inches (2 In), to conform to ASTM A106 or A 53 Grade B, standard weight.
- B. Provide steel pipe and encasement sleeves designed and manufactured in conformance with AWWA C200 and AWWA M11 except as modified herein. Steel to be minimum of A36, ASTM A1011 Grade 36, ASTM A53 Grade B, ASTM A135 Grade B or ASTM A139 Grade B.
- C. Minimum Allowable Steel-Wall Thickness shall be as specified in TABLE 4.1 – STEEL WALL THICKNESS FOR CARRIER PIPE in this Section.
 - 1. Review pipe and fitting design for conditions exceeding those specified herein.
 - 2. Provide pipe with wall thickness of no less than listed in TABLE 4.1 – STEEL WALL THICKNESS FOR CARRIER PIPE in this Section.
- D. Minimum Diameter for Casing Pipe shall be as specified in TABLE 4.2 – MINIMUM DIAMETER FOR CASING PIPE in this Section.
 - 1. Provide casing pipe with wall thickness of no less than listed in TABLE 4.2 – MINIMUM DIAMETER FOR CASING PIPE in this Section.

2. Casing pipe: AWWA C200 new uncoated welded steel.
3. Verify casing diameter required with dimensions of casing spacer.
- E. Provide pipe sections in lengths of not less than sixteen feet (16 Ft) except as required for special sections and not greater than forty feet (40 Ft).
- F. Provide short sections of steel pipe not less than four feet (4 Ft) in length unless indicated on the Drawings or specifically permitted by the Project Manager.
- G. Fittings: Factory forged for sizes two inches (2 In) through twenty inches (20 In); long radius bends; beveled ends for field butt welding; wall thickness equal to or greater than pipe to which fitting is to be welded unless otherwise shown on the Drawings.
- H. Joints:
 1. Standard field joint for steel pipe and encasement sleeve: AWWA C206. Single-welded, butt joint.
 2. Provide mechanically coupled or flanged joints for valves and fittings, as shown on the Drawings. Flanges: AWWA C207, Class D; same diameter and drilling as Class 125 cast iron flanges ASME B16.1. Maintain electrically isolated flanged joints between steel and cast iron by using epoxy-coated bolts, nuts, washers and insulating type gasket.
 3. Elbows to be standard weight seamless elbows per ASTM A106, Grade A or B.
 4. Flanges for pipe twenty inches (20 In) in diameter and less, but more than two inches (2 In), shall be ANSI one hundred fifty pound (150 Lb) flat face, slip on or weld neck flanges, meeting ASTM A105 requirements. Where flanges are to join to valves with raised face flanges, use ANSI one hundred fifty pound (150 Lb) raised flange.
 5. Provide same coating for exposed portions of nuts and bolts as flanges which they secure.
- I. Fabricate flanges with over-size bolt holes, with flanges drilled in pairs, to accommodate insulating sleeves.

2.2 INTERNAL LINING SYSTEMS FOR STEEL PIPE, ALL INSTALLATIONS

- A. Supply steel pipe with epoxy lining, capable of conveying water at temperatures not greater than one hundred forty degrees Fahrenheit (140° F). Provide linings conforming to American National Standards Institute/National Sanitation Foundation (ANSI/NFS) Standard 61 and certification to be from organization accredited by ANSI. Unless otherwise noted, coat exposed (wetted) steel parts of flanges, blind flanges, bolts, access manhole covers, etc., with epoxy lining, as specified in TABLE 4.3 EPOXY LINING in this Section.
- B. Epoxy Lining AWWA C210, White or approved equal for shop and field joint applied, except as modified in this Section. Provide material from same

manufacturer. For Pipe larger than two inches (2 In) in diameter protect interior surface with liquid two-part chemically cured epoxy primer specified for interior surfaces.

1. Total allowable dry film thickness for system:
 - a. Minimum: Twelve (12) mils.
 - b. Maximum: Eighteen (18) mils.
 - c. Minimum field adhesion: Seven hundred pounds per square inch (700 psi).
2. Dry film thicknesses for approved alternate products in accordance with product manufacturer's recommendations.
3. Lining system may consist of three (3) or more coats of same approved alternate epoxy lining without use of separate primer.

2.3 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVEGROUND AND IN VAULTS (EXPOSED)

- A. Provide three (3) coat epoxy/polyurethane coating system as specified in TABLE 4.4 – THREE PART EPOXY/POLYURETHANE COATINGS in this Section. Provide material from same manufacturer.
- B. Total Allowable Dry Film Thickness (DFT) for System:
 1. Minimum: Nine and one-half (9.5) mils
 2. Maximum: Twelve and one-half (12.5) mils
- C. Clean bare pipe free from mud, mill lacquer, oil, grease or other contaminant. Inspect and clean surfaces according to SSPC SP1 to remove oil, grease and loosely adhering deposits prior to blast cleaning. Remove visible oil and grease spots by solvent wiping. Use only approved safety solvents which do not leave residue. Use preheating to remove oil, grease, mill scale, water and ice provided pipe is preheated in uniform manner to avoid distortion.
- D. Remove surface imperfections such as slivers, scabs, burrs, weld spatter and gouges, presence of metallic defects may be cause for rejection of pipe.

PART III: EXECUTION

3.1 PIPING INSTALLATION

- A. Conform to applicable provisions of Section 02400 – Water Lines, except as modified in this Section.
- B. Comply with the following:
 1. Bedding and Backfilling: Conform to requirements of Section 02125 – Excavation and Backfill for Utilities.
 2. For pipes with coating: Do not roll or drag pipe on ground, move pipe in such a manner as not to damage pipe or coating. Carefully inspect pipe for abrasions and repair damaged coating before pipe is installed.
- C. Static Electricity:

1. Properly ground steel pipeline during construction as necessary to prevent build-up of static electricity.
 2. Electrically test where required after installation is complete.
- D. Do not bury steel pipe, unless it is large diameter water line.

3.2 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVE GROUND AND IN VAULTS (EXPOSED) AND EPOXY INTERNAL LINING SYSTEM.

- A. Safety: Paints, coatings and linings specified in this Section are hazardous materials. Vapors may be toxic or explosive. Protective equipment, approved by appropriate regulatory agency, is mandatory for personnel involved in painting, coating and lining operations.
- B. Workmanship:
1. Application: By qualified and experienced workers who are knowledgeable in surface preparation and application of high-performance industrial coatings.
 2. Paint Application Procedures: SSPC Good Painting Practices, Volume 1.
- C. Surface Preparation:
1. Prepare surfaces for painting by using abrasive blasting.
 2. Schedule cleaning and painting so that detrimental amounts of dust or other contaminants do not fall on wet, newly-painted surfaces. Protect surfaces not intended to be painted from effects of cleaning and painting operations.
 3. Prior to blasting, clean surfaces to be coated or lined of grease, oil and dirt by steaming or detergent cleaning in accordance with SSPC SP1.
 4. Metal and Weld Preparation: Remove surface defects such as gouges, pits, welding and torch-cut slag, welding flux and spatter by grinding to one-quarter inch (1/4 In) minimum radius.
 5. Abrasive Material:
 - a. Blast only as much steel as can be coated same day of blasting.
 - b. Use sharp, angular, properly graded abrasive capable of producing depth of profile specified herein. Transport abrasive to job site in moisture-proof bags or airtight bulk containers. Copper slag abrasives are not acceptable.
 - c. After abrasive blast cleaning, verify surface profile with replica tape such as Tes-Tex Coarse or Extra Coarse Press-O-Film Tape or approved equal. Furnish tapes to the Project Manager.
 - d. Do not blast if metal surface may become wet before priming commences or when metal surface is less than five degrees Fahrenheit (5° F) above dew point.
 6. Evaluate degree of cleanliness for surface preparation with use of Pictorial Surface Preparation Standards for Painting Steel

- Surfaces, SSPC Vis1.
7. Remove dust and abrasive residue from freshly blasted surfaces by brushing or blowing with clean, dry air. Test cleanliness by placing three-quarters inch by four inch (3/4 In x 4 In) piece of clear Scotch type tape on blasted surface, then removing and placing tape on three inch by five inch (3 In x 5 In) white index card. Re-clean areas exhibiting dust or residue.
- D. Coating and Lining Application:
1. Environmental Conditions: Do not apply coatings or linings when metal temperature is less than fifty (50) degrees F; when ambient temperature is less than five degrees Fahrenheit (5° F) above dew point; when expected weather conditions are such that ambient temperature will drop below forty degrees Fahrenheit (40° F) within six hours (6 Hrs) after application; or when relative humidity is above eighty-five percent (85%). Measure relative humidity and dew point by use of sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychrometric Tables. Provide dehumidifiers for field-applied coatings and linings to maintain proper humidity levels.
 2. Application Procedures:
 - a. Apply in accordance with manufacturer's recommendations and requirements of this Section. Provide finish free of runs, sags, curtains, pinholes, orange peel, fish eyes, excessive over spray or delaminations.
 - b. Thin materials only with manufacturers recommended thinners. Thin only with an amount required to adjust viscosity for temperature variations, proper atomization and flow-out. Mix material components using mechanical mixers.
 - c. Discard catalyzed materials remaining at end of day.
 3. Thoroughly dry pipe before primer is applied. Apply primer immediately after cleaning surface. Apply succeeding coats before contamination of undersurface occurs.
 4. Cure a minimum of twenty-four hours (24 Hrs) at seventy-seven degrees Fahrenheit (77° F) before successive coats are applied. During curing process, provide force air ventilation in volume sufficient to maintain solvent vapor levels below published threshold limit value. Apply successive coats within recoat threshold time as recommended by coating or lining manufacturer on printed technical data sheets or through written communications. Brush blast joints of pipe which have been shop primed and are to receive intermediate and finish coats in field prior to application of additional coats. After interior coatings are applied, provide forced air ventilation in sufficient volume and for sufficient length of time to ensure proper curing

before filling pipe with water.

E. Testing of Coatings and Linings:

1. Inspect pipe for holidays and damage to coating:
 - a. If test indicates no holidays and coating is damaged, remove deficient or damaged layers of coating and repair in accordance with coating manufacturer's recommendations.
2. Perform holiday test in accordance with NACE Standard Recommended Practice, RPO 188-90, Discontinuity (Holiday) Testing of Protective Coatings.
3. Begin testing of completed coating after coating has sufficiently cured, usually one day (1 D) to five days (5 D). Consult coating manufacturer for specific curing schedule.
4. Perform adhesion test on pipe in accordance with ASTM D4541.
5. For coating thickness of twenty (20) mils or less, test with wet sponge low-voltage holiday detector. For coating thickness in excess of twenty (20) mils, test with high-voltage holiday detector. Perform electrical holiday test with sixty (60) cycle current audio detector. Select test voltage as specified in TABLE 4.5 – MINIMUM VOLTAGES FOR HIGH VOLTAGE SPARK TESTING in this Section.

3.3 JOINTS AND JOINTING

A. Welded Joints:

1. Conform to requirements of Section 02400 – Water Lines.
2. Field weld to be full penetration butt welded joints for steel pipe and encasement sleeves for entire circumference.
3. The City shall employ an independent certified testing laboratory to perform weld acceptance tests on welded joints. Testing Laboratory shall test by X-ray methods for butt welds, for 100 percent of joint welds. The Project Manager has final decision as to suitability of welds tested.

B. Flanged Joints: Conform to requirements of Section 02400 – Water Lines.

C. Joint Grouting and Testing: Conform to requirements of Section 02400 – Water Lines.

3.4 COATINGS AND LININGS INSPECTION RESPONSIBILITIES

- A. Contractor is responsible for quality control of coatings and linings applications and testing and inspection stipulated in this Section. The Project Manager is responsible for quality assurance and reserves the right to inspect or acquire services of an independent third-party inspector who is fully knowledgeable and qualified to inspect surface preparation and application of high-performance coatings at all phases of coatings and linings, work, field- or shop-applied. Contractor is responsible for proper application and performance of coatings and linings whether or not the Project Manager provides such inspection.

PART IV: TABLES

4.1 MINIMUM ALLOWABLE STEEL-WALL THICKNESS

CARRIER PIPE			
Nom. Pipe Size (In.)	Min. Wall		Approx. Wt. Per L.F. Uncoated (Lb.)
	O.D. (In.)	Thick. (In.)	
4	4.50	0.250	11.35
6	6.625	0.280	18.97
8	8.625	0.322	28.55
10	10.75	0.365	40.48
12	12.75	0.375	49.56
16	16.00	0.375	62.58
20	20.00	0.375	78.60

4.2 – MINIMUM DIAMETER FOR CASING PIPE

MINIMUM DIAMETER CASING PIPE (ENCASEMENT SLEEVES)			
Corresp. Casing Pipe Size (In.)	Min. Wall		Approx. Wt. Per L.F. Uncoated (Lb.)
	O.D. (In.)	Thick. (In.)	
8	8.625	0.219	19.64
10	10.75	0.219	24.60
12	12.75	0.219	29.28
16	16.00	0.219	36.86
18	18.00	0.250	47.39
20	20.00	0.250	52.73
24	24.00	0.250	63.41

02250-9

4.3 EPOXY LINING

Surface Preparation 2.0 to 3.0 mils surface profile	SSPC – 5 (64) White Blast Clean
Prime Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy – Buff or approved Equal
Intermediate Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy – Buff or approved Equal
Finish Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy – White or approved Equal

4.4 – THREE PART EPOXY/POLYURETHANE COATINGS

Surface Preparation 2.0 to 3.0 mils surface profile	SSPC SP10 Near White Blast Clean
Prime Coat 4.0 to 6.0 mils DFT	Inhibitive Epoxy Primer or approved equal
Intermediate Coat 4.0 to 6.0 mils DFT	Chemical Resistant Epoxy or approved equal
Finish Coat 1.5 to 2.5 mils DFT	Polyurethane or approved equal Barr Blue Color as approved by the Project Manager

4.5 – MINIMUM VOLTAGES FOR HIGH VOLTAGE SPARK TESTING

MINIMUM VOLTAGES FOR HIGH VOLTAGE SPARK TESTING	
Total Dry Film Thickness (mils)	Suggested Inspection (V)
20 to 40	3,000
41 to 55	4,000
56 to 80	6,000

END OF SECTION

SECTION 02265 POLYURETHANE COATINGS ON STEEL OR DUCTILE IRON PIPE

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Two (2) component polyurethane coating system for use as external coating for steel or ductile iron pipe.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment will be made for work performed under this Section. Include cost of polyurethane coatings in contract unit prices for steel pipe or ductile iron pipe.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

- A. ASTM – American Society for Testing and Materials.
 - 1. ASTM D522 – Standard Test Method for Mandrel Bend Test of Attached Organic Coatings.
- B. AWWA – American Water Works Association.
 - 1. AWWA C210 – Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
- C. CFTS – City of Friendswood Technical Specifications.
- D. SSPC – Steel Structures Painting Council.
 - 1. SSPC PA2 – Measurement of Dry Paint Thickness with Magnetic Gauges.
 - 2. SSPC PA Guide 3 – A Guide to Safety in Paint Application.
 - 3. SSPC PS Guide 17.00 – Guide for Selecting Urethane Painting Systems.
 - 4. SSPC PS10 – Near-White Blast Cleaning.

1.4 SAFETY

- A. Secure, from manufacturer, Material Safety Data Sheet (MSDS) for polyurethane coatings and repair materials listed in this Section.
- B. Safety requirements stated in this specification and in related sections apply in addition to applicable federal, state and local rules and regulations. Comply with instructions of coating manufacturer and requirements of insurance underwriters.
- C. Follow handling and application practices of SSPC PA Guide 3; SSPC PS Guide 17.00; Coating Manufacturer's Material Safety Data Sheet.

1.5 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit coating manufacturer's catalog sheets and technical information for approval, prior to delivery of pipe.
- C. Obtain from coating manufacturer and submit coating "affidavit of compliance" to requirements of this Section stating that coatings were applied in factory and in accordance with manufacturer's minimum requirements.

1.6 DELIVERY, STORAGE and HANDLING

- A. Use standard containers to prevent gelling, thickening deleteriously or forming of gas in closed containers within period of one year (1 Yr) from date of manufacture.
- B. Label each container of separately packaged component clearly and durably to indicate date of manufacture, manufacturer's batch number, quantity, color, component identification and designated name or formula specification, number of coatings together with special instructions. Do not use coating components older than one year (1 Yr).
- C. Deliver coating materials to pipe manufacturer in sealed containers showing designated name, batch number, color, date of manufacture and name of coating manufacturer.
- D. Store material onsite in enclosures, out of direct sunlight in a warm, ventilated and dry area.
- E. Prevent puncture, inappropriate opening or other action which may lead to product contamination.

1.7 QUALITY ASSURANCE

- A. Provide manufacturer's affidavits that pipe was manufactured in compliance with standards referenced in this Section.

PART II: PRODUCTS

2.1 COATING MATERIAL

- A. CORROPIPE II PW – TOUCHUP (two-component) or approved equal; mix in accordance with coating manufacturer's recommendations.
 - 1. For areas less than or equal to six inches (6 In) in diameter, brush apply.
 - 2. For areas greater than six inches (6 In) in diameter, spray apply.
- B. Coating System: Use Type V system which is two (2) package polyisocyanate, polyol-cured urethane coating, mixed in one to one (1:1) ratio at time of application. Components shall be balanced viscosities in their liquid state and not require agitation during use.
- C. Exterior Coating Material: CORROPIPE II-TX and Joint Coating Material CORROPIPE II-PW, manufactured by Madison Chemical Industries, Inc.
- D. Internal Coating Material: Joint Coating Material CORROPIPE II-PW, manufactured by Madison Chemical Industries, Inc

02265-2

- E. Cured Coating Properties:
1. Conversion to Solids by Volume: Ninety-seven percent (97%) plus or minus three percent ($\pm 3\%$).
 2. Temperature Resistance: Minus forty degrees Fahrenheit (-40° F) and plus one hundred degrees Fahrenheit (130° F).
 3. Minimum Adhesion: Five hundred pounds per square inch (500 psi), when applied without primer to ductile iron pipe which has been blasted to comply with SSPC SP10.
 4. Cure Time: For handling in one minute (1 Min) at one hundred twenty degrees Fahrenheit (120° F) and full cure within seven days (7 D) at seventy degrees Fahrenheit (70° F).
 5. Maximum Specific Gravities: Polyisocyanate resin, 1.20. Polyol resin, 1.15.
 6. Minimum Impact Resistance: eighty inch-pounds (80 in-lb) using one inch (1 In) diameter steel ball where coating is applied at thirty (30) mils to ductile iron pipe surface which has been blasted to SSPC No. 10 finish.
 7. Minimum Tensile Strength: Two thousand pounds per square inch (2000 psi).
 8. Hardness: Fifty-five (55) plus or minus five (± 5) Shore D at seventy degrees Fahrenheit (70° F).
 9. Flexibility Resistance: ASTM D522 using one inch (1 In) mandrel. Allow coating to cure for seven days (7 D). Perform testing on test coupons held for fifteen minutes (15 Min) at temperature extremes specified in this Paragraph.

2.2 REPAIR AND TOUCHUP MATERIAL

- A. CORROPIPE II PW [Two (2) component, brush applied or approved equal]. Mix in accordance with coating manufacturer's recommendations.

PART III: EXECUTION

3.1 SURFACE PREPARATION

- A. Remove deposits of oil, grease or other organic contaminants before blast cleaning by using solvent wash as specified in SSPC PA Guide 3. Clean and dry surfaces making them completely dry, free of moisture, dust, grit, oil, grease or other deleterious substances prior to application of coating.
- B. Exterior and Interior Surfaces: SSPC SP10, near-white metal blast cleaning. Blast with clean, hard, sharp cutting abrasives with no steel or cast iron shot in mix.
- C. Ductile Iron Pipe: Prior to start of production blasting, prepare specimens for white metal blast and near-white metal blast using equipment and abrasives proposed for work. During preparation of specimens, Change blasting intensity and abrasive as necessary to provide degree of

02265-3

cleaning required by SSPC SP10, except that color of blasted substrate is not expected to match color of blasted steel. After examination and concurrence by the Project Manager, production blasting may begin. Monitor and control production blasting so that production pipe surfaces match surface of approved blasting specimens.

3.2 THICKNESS

- A. External Coatings: Minimum DFT of twenty-five (25) mils (0.025 inch).
- B. Internal Coatings: Minimum DFT of thirty-five (35) mils.
- C. Thickness Determinations: Use Type 1 magnetic thickness gauge as described in SSPC PA2 specification. Individual readings below ninety percent (90%) of specified minimum are not acceptable. Average individual spot readings [consisting of three (3) point measurements within three inches (3 in) of each other] less than ninety-five percent (95 %) of minimum are not acceptable. Average of all spot readings less than minimum thickness specified are not acceptable.

3.3 FACTORY APPLICATION OF POLYURETHANE COATING

- A. Equipment: Two-component, one to one (1:1) mix ratio, heated airless spray unit.
- B. Temperature: Minimum five degrees Fahrenheit (5° F) above dew point temperature. Temperature of surface shall not be less than sixty degrees Fahrenheit (60° F) during application.
- C. Humidity: Heating of pipe surfaces may be required to meet requirements of Paragraph 2.1E, Cured Coating Properties, when relative humidity exceeds eighty percent (80%).
- D. Do not thin or mix resins; use as received. Store resins at temperature above fifty-five degrees Fahrenheit (55° F) at all times.
- E. Application: Conform to coating manufacturer's recommendations. Apply directly to substrate to achieve specified thickness. Multiple-pass, one (1) coat application process is permitted provided maximum allowable recoat time specified by coating manufacturer is not exceeded.
- F. Recoat only when coating has cured less than maximum time specified by coating manufacturer. When coating has cured for more than recoat time, brush-blast or thoroughly sand coating surface. Blow-off cleaning using clean, dry, high pressure compressed air.
- G. Cure at ambient temperature above zero degrees Fahrenheit (0° F). Do not handle pipe until coating has been allowed to cure as specified in TABLE 4.1 – MINIMUM CURE TIME in this Section.

3.4 JOINTS

- A. Apply coating to unlined pipe surfaces including inside of bell socket and outside of spigot.
- B. Coating thickness on sealing areas of spigot end of pipe exterior: Minimum eight (8) mils (0.008 inch), maximum of ten (10) mils (0.010 inch). Maximum ten (10) mils may be exceeded in spigot end provided

maximum spigot diameter as specified by pipe manufacturer is not exceeded.

3.5 INSPECTION

- A. The Project Manager may inspect coatings at coating applicator's facilities.
- B. Secure approval of surface preparation by coating manufacturer's representative prior to coating application.
- C. Holiday Inspection: Conform to AWWA C210, Section 5.3.3.1. Follow coating manufacturer's recommendation. Conduct inspection any time after coating has reached initial cure. Repair in accordance with Paragraph 3.7, Repair and Field Touchup.

3.6 PIPE INSTALLATION

- A. When required by the Project Manager, provide services of manufacturer's representative for period of not less than two weeks (2 Wks) at beginning of actual pipe laying operations to advise the Contractor regarding installation, including, but not limited to, handling and storing, cleaning and inspecting, coatings repairs and general construction methods as to how they may affect pipe coatings.
- B. Use nylon straps, padded lifts and padded storage skids. Field cuts shall be kept to minimum. Repair damage to coating due to handling or construction practices. See Section 02215 – Ductile Iron Pipe (DIP) and Fittings and Section 02250 – Steel Pipe and Fittings for additional requirements.
- C. Just before each section of pipe is to be placed into trench, conduct visual and holiday inspection. Repair defects in coating system before pipe is installed.

3.7 REPAIR AND FIELD TOUCHUP

- A. Apply repair and touchup materials to holidays and other deficient coating in conformance with factory application of polyurethane coating requirements specified in this Section, excluding equipment requirements.
- B. Repair Procedure – Holidays:
 - 1. Remove traces of oil, grease, dust, dirt and other deleterious materials.
 - 2. Roughen area to be patched by sanding with rough grade forty (40) grit sandpaper.
 - 3. Apply one (1) coat of repair material described above. Work repair material into scratched surface by brushing.
- C. Repair Procedure – Field Cuts or Large Damage:
 - 1. Remove burrs from field cut ends or handling damage and smooth out edge of polyurethane coating.
 - 2. Remove traces of oil, grease, dust, dirt and other deleterious materials

3. Roughen area to be patched with rough grade forty (40) grit sandpaper. Feather edges and include overlap of one inch (1 In) to two inches (2 In) of roughened polyurethane in area to be patched.
 4. Apply thick coat of repair material described above. Work repair material into scratched surface by brushing. Feather edges of repair material into prepared surface. Cover at least one inch (1 In) of roughened area surrounding damage or adjacent to field cut.
- D. Repair Procedure – Thermite Brazed Connection Bonds:
1. Remove polyurethane coating with power wire brush from area on metal surface which is to receive thermite brazed connection.
 2. Grind metal surface to shiny metal with power grinder and coarse grit grinding wheel.
 3. Apply thermite-brazed connection using equipment, charge and procedure recommended by manufacturer of thermite equipment.
 4. After welded surface has cooled to temperature below one hundred thirty degrees Fahrenheit (130° F), apply protective coating repair material to weld, exposed pipe surface and damaged areas of polyurethane coating.
 5. Do not cover or backfill freshly repaired areas of coating at thermite-brazed connection until repair material has completely cured. Allow material to cure in conformance with manufacturer's recommendations.

PART VI: TABLES

4.1 – MINIMUM CURE TIME

Ambient Temperature	Minimum Full Cure Time
Over 70 degrees F	7 days
50 to 70 degrees F	9 days
0 to 50 degrees F	12 Days

END OF SECTION

SECTION 02411 AIR VALVES

PART I: GENERAL

1.1 SECTION INCLUDES

- A. This specification covers air valves in Authority owned and operated facilities.
 - 1. Combination Air Valves (CAV)
 - 2. Combination Air Valves with Bias (CAVB)
- B. Refer to City of Houston Standard Specification Section 02524 – AIR RELEASE AND VAUUM RELIEF VALVES for air valves required on facilities not owned or operated by the Authority required for utility relocations.

1.2 RELATED SECTIONS

- A. Section 01015 – Measurement and Payment
- B. Section 01000 – Submittal Procedures
- C. Section 02125 – Excavation and Backfill for Utilities

1.3 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. Payment for air valves on Authority owned and operated water lines is on unit price basis for each valve installed or as part of the riser lump sum items as indicated on the Bid Form and as shown on Drawings.
 - 2. Payment includes manhole or vault (when required), fittings, vent piping and bollard(s), concrete mow strip, gate valve, and appurtenances necessary for complete installation of valve.
 - a. Estimate for 90 percent payment will be authorized when the manhole is completely installed and surrounding soil backfilled.
 - b. Estimate for 100 percent payment will be authorized when manhole, air valve, and all required appurtenances are fully installed and operational, per Drawings and Specifications, complete in place.
 - 3. Payment for valve assembly on aerial crossing includes fittings, anti-vandalism protection, freeze protection, vent piping and appurtenances necessary for complete installation of valve.
 - 4. Payment for above grade air valve assemblies includes all items for a complete installation as shown in above grade air valve details in Drawings.
 - 5. Refer to Section 01015 - Measurement and Payment for unit price procedures.

- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.4 REFERENCES

- A. ASTM D 429 - Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates
- B. ANSI/AWWA C512 - Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
- C. AWWA C228 – Stainless-Steel Pipe Flanges for Water Service (2-Inch Through 72-Inch)
- D. AWWA C550 - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants
- E. NSF/ANSI 61 - Drinking Water System Components – Health Effects
- F. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels
- G. ASTM A 276 - Standard Specification for Stainless Steel Bars and Shapes.
- H. ASTM A 313 - Standard Specification for Stainless Steel Spring Wire.
- I. ASTM B 584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

1.5 SUBMITTALS

- A. Conform to requirements of Section 01000 - Submittal Procedures.
- B. Submit manufacturer's product data for proposed valves for approval.

1.6 QUALITY CONTROL

- A. Submit manufacturer's affidavit that air valves conform to stated requirements of AWWA C512 and this Section, and that they have been satisfactorily tested in the United States in accordance with AWWA C512. Certified Test report are to be submitted at least seven (7) days prior to valve shipment.
- B. Valves used in potable water service shall be certified to NSF/ANSI 61 Drinking Water System Components – Health Effects.
- C. Coatings used on valve interiors and exterior for potable water service shall be NSF/ANSI 61 certified fusion bonded epoxy in accordance with AWWA C550.
- D. The manufacturer shall demonstrate a minimum of five (5) years' experience in the manufacture of air valves. When requested, the manufacturer shall provide test certificates, dimensional drawings, parts list drawings, and operation and maintenance manuals.
- E. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

PART II: PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. RF Valves, Inc. – Vent-O-Mat, Hanover, MD, USA
- B. International Valve Marketing – Vent-Tech, Sugar Grove, IL, USA
- C. Or Engineer Approved Substitution

2.2 DESCRIPTION & SERVICE

- A. Combination Air Valves (CAV) and Combination Air Valves with Bias (CAVB): CAVs and CAVBs are designed to vent large quantities of air automatically during a liquid piping system filling and to admit large quantities of air automatically when the pressure in the liquid piping system drops below atmospheric pressure. CAVBs slow the approach of water that may create high pressure spikes when the valve suddenly closes and limit internal pressure rise to 1.5 times the working pressure of the valve by controlling the venting of air. In addition, CAVs and CAVBs automatically release small pockets of accumulated air and gases from a liquid piping system while the system operates at a pressure exceeding atmospheric pressure.

2.3 DESIGN & MATERIALS

- A. General:
 - 1. Each air valve shall have a 304 stainless steel, 316 stainless steel or ductile iron body and stainless steel trim. The valve body shall be tubular body constructed to provide an unobstructed circular space between the floats and inner valve body wall.
 - 2. Valve outlet shall be threaded or flanged for connection to vent piping for treated water systems.
 - 3. Valve and flange rating shall equal or exceed the maximum water line test pressure.
 - 4. Floats shall be Ultra High Molecular Weight or High Density Polyethylene with EPDM O-Ring Seals.
- B. Combination Air Valves (CAV): Valves shall be single body design capable of exhausting large amounts of air automatically and admitting large quantities of air automatically when the system pressure drops below atmospheric. In addition, the design shall automatically release small pockets of accumulated air while the system is pressurized and in operation.
 - 1. Combination air valves shall be able to automatically exhaust and admit air without use of levers, pins, springs, hinges, or ball type floats, while the system operates at normal pressure.
 - 2. Combination air valves shall be heavy-duty, single-chamber air and vacuum valves with disc floats. Floats shall include discs drilled with the small and large orifices, and an anti-surge float. Internal clearances around the floats shall be

- equal to the inlet/outlet area. The anti-surge float should be normally opened and have drilled orifices to throttle water flow.
3. Valve shall have ANSI Class 125 flange connections.
 4. Valve shall be adaptable for applications where air exhaust must be restricted and or regulated.
- C. Combination Air Valves with Bias (CAVB): Valves shall be single body design capable of exhausting air automatically in a controlled manor through an “anti-shock” orifice and admitting large quantities of air automatically when the system pressure drops below atmospheric. In addition, the design shall automatically release small pockets of accumulated air while the system is pressurized and in operation. CAVB valves shall not require vacuum greater than 0.75 psig to open fully.

PART III: EXECUTION

3.1 EARTHWORK

- A. Conform to applicable provisions of Section 02125 - Excavation and Backfill for Utilities.

3.2 SETTING VALVES IN MANHOLES AND VAULTS

- A. If required by Engineer, provide services of technical representative of valve manufacturer available on site during installation of valves.
- B. Prior to installing valves, remove foreign matter from within valves. Inspect valves in open and closed position to verify that parts are in satisfactory working condition.
- C. Carefully handle and install valves vertically in such a manner as to prevent damage to any part of the valves. Installation shall be in accordance with the manufacturer’s instructions. Provide nuts, bolts, and gaskets where applicable.
- D. Air valve and gate valve shall be braced adequately to withstand normal pipeline operation pressure and avoid undue stress on the pipe.
- E. Install valves and valve manholes and vaults where indicated on Drawings or by Engineer. Set manholes and vaults plumb and as detailed. Center manholes on valves. Compact cement-stabilized sand around each manhole and vault for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet. Provide above ground vents for manholes and vaults as indicated on Drawings.

3.3 PAINTING OF PIPING AND VALVES

- A. Paint piping and valves located in manholes, stations, and above ground using approved paint in accordance with Section 02265 – Polyurethane Coatings on Steel and Ductile Iron Pipes.

END OF SECTION

SECTION 02412 CHECK VALVES

PART I: GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Furnish labor, materials, equipment, and incidentals necessary to install and put into operation, check valves as specified herein and shown on the drawings.
- B. Related Specification Sections include but are not limited to:
 - 1. Section 0100 – Submittal Procedures

1.2 REFERENCES

- A. Reference Standards:
 - 1. Reference standards cited in this specification refer to the current reference standard published at the time of the latest revision date logged at the end of this specification, unless a date is specifically cited.

1.3 SUBMITTALS

- A. Contractor shall submit manufacturer's technical information on all valves and materials of construction in accordance with Section 0100.
- B. All Submittals shall be approved by the Owner prior to delivery and/or fabrication for specials.

1.4 MEASUREMENT AND PAYMENT

- A. If indicated as a bid item, measurement shall be as indicated on bid form. Payment shall include all materials, equipment, labor, and testing to complete the installation.

1.5 WARRANTY

- A. Manufacturer Warranty:
 - 1. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced and the unit(s) restored to service at no expense to the Owner.

PART II: PRODUCTS

2.1 CHECK VALVES

- A. Manufacturers:
 - 1. Manufacturer List:
 - a. DeZurik
 - b. or approved equal
 - 2. The list above does not imply that the manufacturer's standard product is acceptable. The successful manufacturer will be required to conform to all specifications and will be required to submit a statement stating the meter is appropriate giving the

provided upstream and downstream straight run of pipe length shown in the plans.

B. Description:

1. The contractor shall furnish and install swing flex check valves, APCO Model CVS-250. Closure device shall be lever and weight.
2. Check Valve body shall be ductile iron ASTM A536 Grade 65-45-12 and have a Buna-N (NBR), ASTM D2000-B6 disc.
3. Nuts, Bolts, and Studs shall be Type 316 Stainless Steel.
4. The check valves shall work without damage to the check valve over the entire range of operating conditions. Slamming shut of the check valve will not be allowed. If slamming occurs the contractor shall adjust the valve accordingly.
5. The valve disc shall be of one piece construction, precision molded with an integral o-ring type sealing surface and contain alloy steel and nylon reinforcement in the flexible hinge area.
6. The valve body shall have full flow equal to nominal pipe diameter at all points through the valve. The seating surface shall be on a 45° angle to minimize disc travel. The top access point shall be full size, allowing removal of the disc without removing the valve from the pipeline. The access cover shall be domed in shape, to allow the disc to be fully operational in lines containing high solids content.
7. Backflow capabilities shall be available by means of a screw type backflow actuator. The actuator shall be factory installed.
8. The exterior of the valve shall be coated with an approved fusion bonded epoxy coating.
9. The valve shall have an interior protective portland cement mortar lining in conformance with ANSI/AWWA C104/A21.4.
10. The valve shall be cycle tested 1,000,000 times with no signs of wear or distortion to the valve disc or seat and shall remain drop tight at both high and low pressures. The test results shall be independently certified.
11. Materials shall be certified to the following A.S.T.M. specifications:

Body & cover	Ductile iron	ASTM A536 Grade 65-45-12
Disc	Buna-N (NBR)	ASTM D 2000-B6
Disc Stem	Stainless Steel Type 303	ASTM A582
Interior Coating	Fusion Bonded Epoxy	ANSI/NSF 61 approved
Exterior Coating	Fusion Bonded Epoxy	ANSI/NSF 61 approved
Coatings per Sec. 02265		

PART III: EXECUTION

3.1 INSTALLATION

- A. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice.
- B. The Contractor shall provide a supervisor at the work site during all construction operations. The supervisor shall have the authority to sign change orders, coordinate work and make decisions pertaining to the fulfillment of the contract.
- C. The Contractor and all workmen employed by him shall conduct all operations in a clean and sanitary manner and in conformance with all aspects of the contract documents.

END OF SECTION

SECTION 02413 ECCENTRIC PLUG VALVES

PART I: GENERAL

1.1 SECTION INCLUDES

- A. Eccentric Plug valves, 4-72" (100-1800mm), of rectangular port construction with resilient faced cylindrical plugs eccentrically offset from the seat, for the purpose of providing isolation or throttling control as indicated.

1.2 REFERENCES

- A. ASTM A126 Class B "Gray Iron Castings for Valves, Flanges and Pipe Fittings"
- B. ASME B16.1 "Pipe Flanges and Flanged Fittings"
- C. AWWA C517 "Resilient-Seated Cast-Iron Eccentric Plug Valves"
- D. AWWA C111 "Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings"
- E. NSF/ANSI 61 "Drinking Water System Components - Health Effects"
- F. NSF/ANSI 372 "Drinking Water System Components - Lead Content"

1.3 SUBMITTALS

- A. Submit detailed product data and descriptive literature to include dimensions and materials of construction.
- B. Provide shop drawings to show installation arrangement of major component assemblies.

1.4 QUALITY ASSURANCE

- A. Supplier shall have been manufacturing eccentric plug valves for a period of at least ten years. At the engineer's request, supplier shall provide a list of installations involving equipment of similar size and application.
- B. Valves and Actuators shall be warranted by the manufacturer for defects in materials and workmanship for a period of two years (24 months) from date of shipment.
- C. Each valve and actuator shall be assembled, adjusted and tested as a unit by the valve manufacturer.

PART II: PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. DeZURIK
 - 1. DeZURIK Eccentric Plug Valve.

2.2 ECCENTRIC PLUG VALVES

- A. Plugs shall be solid one piece, Cast Iron ASTM A126 Class B or Ductile Iron ASTM 536 Grade 65- 45-12. The plug shall have a cylindrical seating surface eccentrically offset from the center of the shaft. Plug shall not

- contact the seat until at least 90% closed. Resilient plug facing shall be Chloroprene (CR). Spherical shaped plugs are not acceptable.
- B. Bodies and covers shall be Cast Iron ASTM A126 Class B. Ports shall be rectangular. Round ports are not acceptable. Bearings shall be sleeve type and made of sintered, oil impregnated permanently lubricated type 316 stainless steel for sizes 4-18" (100-450mm) and ASTM A743 Grade CF8M for sizes 20-36" (500-800mm). In valves larger than 36" (900mm), the upper and lower plug journals shall be fitted with ASTM A240 type 316 stainless sleeves with body bearings of ASTM B30, Alloy C95400 aluminum bronze.
 - C. Seats on shall be 1/8" thick welded overlay of not less than 95% pure nickel. Seat shall be at least 1/2" wide, 1/8" thick through entire width and raised. The raised surface shall be completely covered with nickel to ensure that the resilient plug face contacts only the nickel seat.
 - D. Adjustable packing shall be Acrylonitrile-Butadiene (NBR) multiple V-ring type, with a packing gland follower. Packing gland shall permit inspection, adjustment or complete replacement of packing without disturbing any part of the valve or actuator assembly, except the gland follower. Non-adjustable packing or packing requiring actuator removal to replace the packing, is not acceptable.
 - E. Pressure ratings shall be 175 psi (1210 kPa) on valve sizes through 12" (300mm) and 150 psi (1035 kPa) for 14" (350mm) and larger. Every valve shall be given a certified hydrostatic shell test and seat test, with test reports being available upon request.
 - F. All valves larger than 6" shall be installed with worm gear actuators. All gearing shall be enclosed in a cast iron housing, with outboard seals to protect the bearings and other internal components. The actuator shaft and gear quadrant shall be supported on permanently lubricated bronze bearings.
 - G. Buried actuators shall be 90% grease filled. Input shaft and fasteners shall be stainless steel. Actuator mounting brackets shall be totally enclosed. Other actuators to be installed according to drawings or customer specifications.
 - H. End connections shall meet or exceed the latest revisions of AWWA C517 and other applicable standards. End Connections shall be Flanged drilled per ASME B16.1 and/or Mechanical Joint per AWWA C111.
 - I. When specified, valves shall be NSF/ANSI 372 certified lead-free and NSF/ANSI 61 certified for drinking water.

2.3 INSTALLATION

- A. In applications of liquids with suspended solids or dirty gases:
 - 1. For valves installed in a vertical pipeline, or where the possibility of overhead drain-back exists, install the valve with the seat at the top to prevent drain-back solids from settling into the valve body.
 - 2. For valves installed in a horizontal pipeline, install the valve so the plug rotates up when opened. Install the valve with the higher pressure against the seat end of the valve.

- B. In applications of clean liquids and gases for eccentric plug valves installed in a horizontal or vertical pipeline, it is recommended that the valve be installed with the higher pressure against the end opposite the seat.

END OF SECTION

SECTION 02505 SANITARY SEWER SERVICE STUB-OUTS OR RECONNECTIONS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Installation of service stub-outs in sanitary sewers serving areas where sanitary sewer service did not previously exist.
- B. Reconnection of existing service connections along parallel, replacement or rehabilitated sanitary sewers.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

- 1. Payment for sanitary sewer service stub-outs or service reconnections with stacks located within five feet (5 Ft) of sanitary sewer main centerline is on a unit price basis for each stub-out or reconnection. Payment shall be made for each service stub-out or reconnection installed complete in place, including service connections, couplings and adapters disconnecting existing services, reconnecting new service, fittings, excavation and backfill.
- 2. Payment for sanitary sewer service stub-outs or service reconnections without stacks located within five feet (5 Ft) of sanitary sewer main is on a unit price basis for each stub-out or reconnection. Payment shall be made for each service stub-out or reconnection installed complete in place, including service connections, couplings and adapters disconnecting existing services, reconnecting new service, fittings, excavation, backfill and testing.
- 3. Payment for sanitary sewer service lines more than five feet (5 Ft) laterally from sanitary sewer main is on a linear foot basis. Measurement shall be taken along centerline of pipe from centerline of lateral connection or stack to end of service for service stub-outs laid in open-cut excavation. Payment shall be made for each linear foot of pipe installed, complete in place, including sanitary sewer pipe, excavation, shoring, bedding, backfill and accessories in addition to payment for sanitary sewer stub-outs or service connections with or without stacks. Augered pipe for service stub-outs shall be paid as provided in Section 02275 – Pipe and Casing Augering for Sanitary Sewers.
- 4. Pay estimates for progress payments shall be made as measured above according to following schedule:
 - a. An estimate for ninety-five percent (95%) payment shall be authorized when stub-out or reconnection is completely installed and backfilled.

- b. An estimate for one hundred percent (100%) payment shall be authorized when stub-out or reconnection has been tested as specified in Section 02525 – Acceptance Testing for Gravity Sanitary Sewer Lines.
5. One (1) or more connections discharging into a common point are considered one (1) service connection. The Contractor shall not increase the quantity of service reconnections without approval of the Project Manager. The Project Manager may require connections to be relocated to avoid having more than two (2) service connections per reconnection to sanitary sewer.
6. Protruding service connections which must be removed to allow liner insertion are paid as a service reconnection when connected. If abandoned, they shall be paid as an abandoned connection.
7. Payment for abandonment of service connections is on a unit price basis for each abandoned service connection. No separate payment shall be made for abandonment of a service connection unless excavation is required. No separate payment shall be made for excavation of sanitary sewer services within new or replacement sanitary sewer trench.
8. No separate payment shall be made for removal of existing sanitary sewer service stub-outs. Include payment in the unit price for Section 02505 – Sanitary Sewer Service Stub-outs or Reconnections.
9. No separate payment shall be made for abandoned service connections when service to be abandoned is within four feet (4 Ft) of active connection. Payment for only one (1) abandoned service connection shall be allowed when second (2nd) abandoned connection is within four feet (4 Ft) of first (1st).
10. If faulty remote cut is later corrected using procedures specified for reconnection by excavation, only one (1) reconnection shall be allowed for payment.
11. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

- A. ASTM – American Society for Testing and Materials.
 1. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 2. ASTM D3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 3. ASTM D3212 – Standard Specification for Joints for Drain and

Sewer Plastic Pipes Using Flexible Elastomeric Seals.

- B. CFTS – City of Friendswood Technical Specifications.

1.4 PERFORMANCE REQUIREMENTS

- A. Accurately locate in field all proposed service stub-outs along new sanitary sewer main.
- B. Accurately locate in field existing service connections and proposed service stub-outs along alignment of new parallel or replacement sanitary sewer main.

1.5 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit product data for each pipe product, fitting, coupling and adapter.
- C. Show reconnected services on record drawings. Give exact distance from each service connection to nearest downstream manhole.

PART II: PRODUCTS

2.1 PVC SERVICE CONNECTION

- A. For stub-outs, use PVC sanitary sewer pipe of four inch (4 In) through ten inch (10 In) diameter, conforming to ASTM D1784 and ASTM D3034, with cell classification of 12454-B. SDR (ratio of diameter to wall thickness) shall be twenty-six (26) for pipe ten inches (10 In) in diameter or less.
- B. PVC pipe shall be gasket jointed with gasket conforming to ASTM D3212.
- C. Provide service connection pipe in sizes shown on the Drawings. For reconnection of existing services, select service connection pipe diameter to match existing service diameter. Reconnections to rehabilitated sanitary sewer mains shall be limited to maximum service connection diameter as specified in TABLE 4.1 – MAXIMUM SERVICE CONNECTION DIAMETER in this Section.
- D. Subject to above limits, provide a six inch (6 In) service connection when more than one (1) service discharges into a single pipe.
- E. Connect service pipes to parallel or replacement sanitary sewer mains with prefabricated, full-bodied tee or wye fittings conforming to the specifications for sanitary sewer main pipe material as specified in other sections for sanitary sewers up to eighteen inches (18 In) in diameter.
- F. Where sanitary sewers are installed using pipe augering or tunneling or where sanitary sewer is greater than eighteen inches (18 In) in diameter, use Fowler "Inserta-Tee" to connect service to sanitary sewer main.

2.2 PIPE SADDLES

- A. Use pipe saddles only on sanitary sewer mains that have been rehabilitated using partial replacement, sliplining, cured in place lining or pipe-bursting methods. Comply with Paragraph 2.1.E for new parallel

and replacement sanitary sewer mains.

- B. Supply one (1) piece prefabricated saddle, either polyethylene or PVC, with neoprene gasket to accomplish complete seal. Use saddle fabricated to fit outside diameter of connecting pipe. Protruding lip of saddle must be at least five-eighths inch (5/8 In) long with grooves or ridges to retain stainless steel band clamps.
- C. Use one-half inch (1/2 In) stainless steel band clamps for securing saddles to sanitary sewer pipe.

2.3 COUPLINGS AND ADAPTERS

- A. For connections between new PVC pipe stub-outs and existing service, four inch (4 In), six inch (6 In) or eight inch (8 In) diameter, use flexible adapter coupling consisting of neoprene gasket and stainless steel shear rings with one-half inch (1/2 In) stainless steel band clamps:
 - 1. Fernco Pipe Connectors, Inc. Series 1055 with shear ring SR-8
 - 2. Band Seal by Mission Rubber Co., Inc.
 - 3. Approved equal.
- B. For connections between new PVC pipe stub-out and new service, use rubber-gasket adapter coupling:
 - 1. GPK Products, Inc.
 - 2. IPS & Sanitary sewer Adapter
 - 3. Approved equal.

2.4 STACKS

- A. Provide stacks for service connections wherever crown of sanitary sewer is eight feet (8 Ft) or more below finished grade.
- B. Construct stacks of same material as sanitary sewer and as shown on the Drawings.
- C. Provide stacks of same nominal diameter at sanitary service line.

2.5 PLUGS AND CAPS

- A. Seal upstream end of unconnected sanitary sewer service stub-outs with rubber gasket plugs or caps of same pipe type and size. Provide plugs or caps by GPK Products, Inc. or approved equal.

PART III: EXECUTION

3.1 PERFORMANCE REQUIREMENTS

- A. Provide minimum of seventy-two hours (72 Hrs) notice to customers whose sanitary sewer service shall potentially be interrupted.
- B. Reconnect service connections, including those that go to unoccupied or abandoned buildings or to vacant lots, unless directed otherwise by the Project Manager.
- C. Reconnection by excavation method shall include stack and fittings and required pipe length to reconnect service line.
- D. Connect services eight inches (8 In) in diameter and larger to sanitary

sewer by construction of manhole. Refer to appropriate section on manholes for construction and payment.

- E. Connections to sanitary sewer lines rehabilitated by either the cured-in-place or sliplining method shall conform to the following:
 - 1. Accurately field locate service connections, whether in service or not, along rehabilitated sanitary sewer line.
 - 2. Properly disconnect existing connections from sanitary sewer and reconnect to rehabilitated sanitary sewer lines, as described in this Section.
 - 3. Complete reconnection of service lines within of twenty-four hours (24 Hrs) after cured-in-place liner installation, and within seventy-two hours (72 Hrs) after disconnection for sliplining of sanitary sewer lines.
 - 4. Reconnect services on `sanitary sewer lines rehabilitated with cured-in-place liner or sliplining at twelve feet (12 In) depth or less by excavation method. The Project Manager reserves right to require service connections by excavation when remote cut service connection damages lines.
- F. Reconnections to new or replacement sanitary sewer lines shall conform to the following:
 - 1. Accurately field locate service connections, whether in service or not, along sanitary sewer line. For new and replacement sanitary sewers, service connections may be located as pipe laying progresses from downstream to upstream.
 - 2. Properly disconnect existing connections from sanitary sewer and reconnect the new or replacement sanitary sewer line, as described in this Section.
 - 3. Complete reconnection of service lines to restore sanitary sewer service in the shortest possible time.
 - 4. Reconnect services on new or replacement sanitary sewer lines at twelve feet (12 In) depth or less by excavation method. The Project Manager reserves right to require service connections by excavation when remote cut service connection damages lines.

3.2 PROTECTION

- A. Provide barricades, warning lights and signs for excavations created for service connections. Conform to requirements of Section 01505 – Temporary Facilities and Control.
- B. Do not allow sand, debris or runoff to enter sanitary sewer system.

3.3 PREPARATION

- A. Rehabilitated, new or replacement of sanitary sewer lines: Determine existing sanitary sewer locations and number of existing service connections from closed-circuit television (CCTV) inspection DVD's or from field survey. Accurately field locate existing service connections,

whether in service or not. Use existing service locations to connect or reconnect service lines or liner.

- B. For rehabilitated sanitary sewer lines, allow sliplining to normalize to ambient temperature and recover from imposed stretch. For cured-in-place liners, verify that liner is completely cured. For sliplining connection procedures, refer to manufacturers recommendations.

3.4 EXCAVATION AND BACKFILL

- A. Excavate in accordance with Section 02125 – Excavation and Backfill for Utilities.
- B. Perform the Work in accordance with OSHA standards. Employ Trench Safety System as specified in Section 02280 – Trench Safety Systems for excavations requiring trench safety.
- C. Install and operate necessary ground water and surface water control measures in accordance with requirements of Section 01585 – Control of Ground and Surface Water.
- D. Determine locations where limited access, buildings or structure preclude use of mechanical excavation equipment. Obtain approval from the Project Manager for hand excavation.

3.5 RECONNECTION BY EXCAVATION METHOD

- A. Strap on saddle using stainless steel band on each side of saddle. Tighten bands to produce watertight seal of saddle gasket to sanitary sewer pipe. See paragraph 3.6 for additional requirements.
- B. Remove and replace cracked, offset or leaking service line for up to five feet (5 In), measured horizontally, from center of sanitary sewer pipe.
- C. Make up connection between sanitary sewer pipe and service line using PVC sanitary sewer pipe and approved fittings and couplings.
- D. Test service connections before backfilling.
- E. Embed entire service connection in cement stabilized sand as shown on the Drawings. Place and compact trench zone backfill in compliance with Section 02125 – Excavation and Backfill for Utilities.

3.6 RECONNECTION BY REMOTE METHOD FOR CURED-IN-PLACE LINERS OR SLIPLINING

- A. Make service reconnections using remote-operated cutting tools on cured-in-place liners at depth greater than twelve feet (12 Ft).
- B. Employ method and equipment that restore service connection capacity to not less than ninety percent (90%) of original capacity.
- C. For reconnection to sanitary sewer lines that have been sliplined, follow these requirements:
 - 1. Remove portion of existing sanitary sewer pipe or carrier pipe to expose liner pipe. Provide sufficient working space for installing prefabricated pipe saddle.
 - 2. Carefully cut liner pipe to make hole to accept stub-out protruding from the backside of saddle connection.

- D. Immediately open missed connections and repair holes drilled in error using method approved by the Project Manager.
- E. Embed service connection and service line as specified for sanitary sewer main as shown on the Drawings. Place and compact trench zone backfill in compliance with Section 02125 – Excavation and Backfill for Utilities.

3.7 RECONNECTION ON NEW OR REPLACEMENT SEGMENTS

- A. Install service connections on sanitary sewer main.
- B. Remove and replace cracked, offset or leaking service line for up to five feet (5 Ft), measured horizontally, from centerline of sanitary sewer main.
- C. Make up connection between main and existing service line using PVC sanitary sewer pipe and approved couplings, as shown on the Drawings.
- D. Test service connections before backfilling.
- E. Embed service connection and service line as specified for sanitary sewer main as shown on the Drawings. Place and compact trench zone backfill in compliance with Section 02125 – Excavation and Backfill for Utilities.

3.8 INSTALLATION OF NEW SERVICE STUB-OUTS

- A. Install service connections on sanitary sewer pipe for each service connection in accordance with paragraphs 3.5, 3.6 and 3.7. Provide length of stub-out indicated on the Drawings. Install plug or cap on upstream end of service stub-out as needed.
- B. Test service connections before backfilling.
- C. Embed service connection and service line as specified for sanitary sewer main and as shown on the Drawings. Place and compact trench zone backfill in compliance with Section 02125 – Excavation and Backfill for Utilities. Install a minimum two foot (2 Ft) length of magnetic locating tape along axis of service stub-out and nine inches (9 In) to twelve inches (12 In) above crown of pipe, at end of stub-out.

3.9 TESTING

- A. Complete testing and acceptance of downstream sanitary sewers as applicable. Provide for compliance with requirements of this Section.
- B. Test service reconnections and service stub-outs. Follow applicable procedures given in Section 02525 – Acceptance Testing for Gravity Sanitary Sewer Lines to perform smoke testing to confirm reconnection.
- C. Perform post installation CCTV inspection as specified in Section 02520 – Television Inspection of Sanitary Sewer Lines to show locations of service connections.

3.10 CLEANUP

- A. Backfill excavation as specified in Section 02125 – Excavation and Backfill for Utilities.
- B. Replace pavement or sidewalks removed or damaged by excavation in

accordance with Section 02845 – Pavement Repair and Resurfacing. In unpaved areas, bring surface to grade and slope surrounding excavation. Replace minimum of four inches (4 In) of topsoil and seed according to requirements of Section 02910 – Hydromulch Seeding.

PART IV: TABLES

4.1 – MAXIMUM SERVICE CONNECTION DIAMETER

Sanitary Sewer Main Diameter	Maximum Service Connection Diameter
8" or less	4"
10" or greater	6"

END OF SECTION

SECTION 02510 SANITARY SEWER FORCE MAINS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Sanitary sewer force mains.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Payment for installation of sanitary sewer force main pipe by open-cut, augered with or without casing, or within limits of Potentially Petroleum Contaminated Area (PPCA) is on a linear foot basis. Measurement shall be taken along center line of pipe from end to end. Payment shall be made for each foot of sanitary sewer force main pipe installed, complete in place including pipe, excavation, bedding, backfill and special backfill, shoring, earthwork, connections to existing manholes, acceptance testing and pipe and accessories.
2. Payment for installation of sanitary sewer force main pipe crossing a stream or other body of water is on a lump sum basis.
3. The Unit Price item identifies line segments between stations as shown on the Drawings.
4. Refer to Section 01270 – Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum):

1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

A. ACI – American Concrete Institute.

1. ACI 318 – ACI Building Code and Commentary.

B. ASTM – American Society for Testing and Material.

1. ASTM D696 – Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 C and 30 C with a Vitreous Silica Dilatometer.
2. ASTM D2310 – Standard Classification for Machine-Made “Fiberglass” (Glass-Fiber-Reinforced- Thermosetting-Resin) Pipe.
3. ASTM D2992 – Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for “Fiberglass” (Glass-Fiber Reinforced Thermosetting-Resin) Pipe and Fittings.
4. ASTM D2996 – Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

- C. CFTS – City of Friendswood Technical Specifications.
- D. Uni-Bell UNI-B-3 Polyvinyl Chloride (PVC) Pressure Pipe (complying with AWWA C 900).

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit proposed methods, equipment, materials and sequence of operations for sanitary sewer force main construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.
- C. Sanitary sewer force mains twenty-four inches (24 In) in diameter and larger: Submit shop drawings and design calculations for joint restraint systems using reinforced concrete encasement of pressure pipe and fittings.
- D. Submit qualifications, proposed methods, equipment, materials and sequence for acceptance testing of sanitary sewer force main. Submit evidence of line proving by pigging for at least three (3) projects of equal or greater scope; project list shall include dates, size and length of pipe, location, owner name, contact person and telephone number. Provide certificate of training by manufacturer of pigging equipment being used.
- E. Submit test reports as specified in Part III of this Section.

PART II: PRODUCTS

2.1 PIPE FITTING MATERIAL SCHEDULE

- A. Unless otherwise shown on the Drawings, use pipe materials that conform to requirements specified in one (1) or more of the following Sections:
 - 1. Section 02215 – Ductile Iron Pipe (DIP) and Fittings.
 - 2. Section 02220 – High Density Polyethylene Pipe (HDPE).
 - 3. Section 02235 – Polyvinyl Chloride Pipe (PVC).

2.2 THRUST RESTRAINT

- A. Unless otherwise shown on the Drawings, provide concrete thrust blocking for sanitary sewer force mains up to twelve inches (12 In) in diameter, to prevent movement of buried lines under pressure at bends, tees, caps, valves and hydrants. Blocking shall be Portland cement concrete, as specified in Section 03300 – Structural Concrete. Place concrete in accordance with details on the Drawings. Place thrust blocks between undisturbed ground and fittings. Anchor fittings to thrust blocks so that pipe and fitting joints are accessible for repairs. Concrete shall extend from six inches (6 In) below pipe or fitting to twelve inches (12 In) above.
- B. For sanitary sewer force mains larger than twelve inches (12 In) in diameter and where indicated on the Drawings, provide restrained joints conforming to requirements of sanitary sewer force main pipe material

02510-2

- specifications. Install restrained joints for length of pipe on both sides of each bend or fitting for full length shown on the Drawings.
- C. Horizontal and vertical bends between zero degrees (0°) and ten degrees (10°) deflection angle shall not require thrust blocks or harnessed or restrained joints.
 - D. Horizontal and vertical bends between ten degrees (10°) and ninety degrees (90°) deflection angle shall have thrust restraint as shown on the Drawings.
 - E. Provide thrust restraint at tees, plugs, blowoff drains, valves and caps, or other locations as indicated on the Drawings.
 - F. Reinforced concrete encasement of sanitary sewer force main pipe and fittings may be used in lieu of manufactured joint restraint systems. Alternate joint restraint systems using reinforced concrete encasement shall conform to following design requirements.
 - 1. Design calculations shall be performed and sealed by Professional Engineer licensed in the State of Texas.
 - 2. Base design calculations upon soil parameters quantified in geotechnical report for site where alternative thrust restraint system is to be installed. When data is not available for site, use parameters recommended by geotechnical engineer.
 - 3. The design system pressure shall be the specified test pressure.
 - 4. The following safety factors shall be used in sizing restraint system:
 - a. Apply factor of safety equal to one and one-half (1.5) for passive soil resistance.
 - b. Apply factor of safety equal to two (2.0) for soil friction.
 - 5. Encasement shall remain entirely within standard trench width and terminate on both ends at pipe bell or coupling.
 - 6. Concrete encasement reinforcement steel shall be designed for all loads, including internal pressure and longitudinal forces. Concrete design shall be in accordance with ACI 318.

PART III: EXECUTION

3.1 PIPE INSTALLATION BY OPEN-CUT

- A. Perform excavation, bedding and backfill in accordance with Section 02125 – Excavation and Backfill for Utilities.
- B. Wrap ductile iron pipe (DIP) and fittings with polyethylene wrap in accordance with requirements of Section 02260 – Polyethylene Wrap. Do not install polyethylene wrap on ductile iron pipe protected by cathodic protection system, or fusion bonded or polyurethane coated fittings.
- C. Install pipe in accordance with pipe manufacturer's recommendations and as specified in following paragraphs.
- D. Install pipe only after excavation is completed, bottom of trench is fine graded, bedding material is installed and trench has been approved by

02510-3

the Project Manager.

- E. Install pipe to line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in trench so interior surfaces of pipe follow grades and alignment indicated. Provide bell holes where necessary.
- F. Install pipe with spigot ends toward direction of flow. Form concentric joint with each section of adjoining pipe so as to prevent offsets.
- G. Keep interior of pipe clean as installation progresses. Where cleaning after laying pipe is difficult because of small pipe size, use suitable swab or drag in pipe and pull it forward past each joint immediately after joint has been completed. Remove foreign material and debris from pipe.
- H. Provide lubricant, place and drive home newly-laid pipe with come-along winches so as to eliminate damage to pipe. Install pipe to "home" mark where provided. Use of backhoes or similar powered equipment shall not be allowed unless protective measures are provided and approved in advance by the Project Manager.
- I. Keep excavations free of water during construction and until final inspection.
- J. When the Work is not in progress, cover exposed ends of pipes with approved plug to prevent foreign material from entering pipe.
- K. Where sanitary sewer force main is to be installed under existing water line with separation distance of less than two feet (2 Ft), install one (1) full joint length of pipe, minimum eighteen foot (18 Ft) length, centered on water line and maintain minimum six inch (6 In) separation distance. Embed sanitary sewer force main in cement-stabilized sand for minimum distance of nine feet (9 Ft) on each side of crossing.

3.2 PIPE INSTALLATION OTHER THAN OPEN-CUT

- A. For installation of pipe by augering, jacking or tunneling, conform to requirements of specification section of augering or tunneling work.

3.3 HYDROSTATIC TESTING

- A. After pipe and appurtenance have been installed, test line and drain. Prevent damage to the Work or adjacent areas. Use clean water to perform tests.
- B. The Project Manager may direct tests of relatively short sections of completed lines to minimize traffic problems or potential public hazards.
- C. Test pipe in presence of the Project Manager.
- D. Test pipe at one hundred fifty pounds per square inch (150 psi) or one and one-half (1.5) times design pressure of pipe, whichever is greater. Design pressure of sanitary sewer force main shall be rated total dynamic head of lift station pump.
- E. Test pipe at required pressure for minimum of four hours (4 Hrs) according to requirements of UNI-B-3.
- F. Maximum allowable leakage shall be as calculated by following formula:

$$L = (S) (D) (P_{0.5}) / 133,200$$

Where: L = Leakage in gallons per hour.
S = Length of pipe in feet.
D = Inside diameter of pipe in inches.
P = Pressure in pounds per square inch.

- G. Correct defects, cracks or leakage by replacement of defective items or by repairs as approved by the Project Manager.
- H. Plug openings in sanitary sewer force main after testing and flushing. Use cast iron plugs or blind flanges to prevent debris from entering tested pipeline.

3.4 PIGGING TEST

- A. After completion of hydrostatic testing and prior to final acceptance, test sanitary sewer force mains longer than two hundred feet (200 Ft) by pigging to ensure pipe is free of obstructions.
- B. Pigs: Provide proving pigs manufactured of open-cell polyurethane foam body, without coating or abrasives which would scratch or otherwise damage interior pipe wall surface or lining. Pigs shall be able to pass through reductions of up to sixty-five percent (65%) of nominal cross-sectional area of pipe. Pigs shall be able to pass through standard fittings such as forty-five degree (45°) and ninety degree (90°) elbows, crosses, tees, wyes, gate valves or plug valves, as applicable to sanitary sewer force main being tested.
- C. Test Execution: Conduct pigging test in presence of the Project Manager. Provide at least forty-eight hours (48 Hrs) notice of scheduled pigging of sanitary sewer force main prior to commencing test.

END OF SECTION

SECTION 02515 ABANDONMENT OF SANITARY SEWERS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Abandonment in place of existing sanitary sewers, junction structures, manholes and sanitary sewer force mains.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Payment for grout fill and abandonment of existing sanitary sewers, including boxes and elliptical shaped sanitary sewers, is on linear foot basis for each diameter of sanitary sewer being abandoned. Measurement shall be along centerline of sanitary sewer from centerline to centerline of manholes.
2. Payment for grout fill and abandonment of sanitary sewer manholes or junction structure is by each manhole or junction structure abandoned in conformance with this Section.
3. Payment shall be full compensation for all material, equipment and labor required for complete abandonment grouting, including air venting, testing, temporary plugs, PVC pipes and incidentals.
4. No separate payment shall be made for plugging and abandoning sanitary sewer force mains. Include cost of such abandonment in related work.
5. Refer to Section 01270 – Measurement and Payment for unit price procedures.
6. Acceptability of grout material is based on achieving average strength within range of seventy-five pounds per square inch (75 psi) to one hundred fifty pounds per square inch (150 psi) as defined in Paragraph 2.1.A.1. Grout that is out of range after placement may be accepted with price adjustment of one (1.0 %) percent price deduction for each pound per square inch (psi) average compressive strength below seventy-five pounds per square inch (75 psi) and one-half percent (0.5 %) price deduction for each psi average compressive strength above one hundred fifty pounds per square inch (150 psi), as applicable to material volume represented by test series. Shrinkage in grout material placements shall be remedied by the Contractor according to Paragraph 3.4.H without additional compensation.

B. Stipulated Price (Lump Sum):

1. If Contract is Stipulated Price Contract, payment for Work in this Section is included in Total Stipulated Price.

1.3 DEFINITIONS

- A. Abandonment: Sanitary sewer abandonment consists of demolition and removal of portions of manholes existing within specified depth of surface and abandonment in place of sanitary sewer lines and manholes as specified in this Section.
- B. Flowable Fill: Flowable fill (abandonment grout) shall be controlled low-strength material consisting of fluid mixture of cement, aggregate, water and with admixtures as necessary to provide workable properties. Placement of flowable fill may be by grouting techniques in sanitary sewers or other restricted areas or as mass placement by chutes or tremie methods in unrestricted locations with open access. Long-term hardened strength shall be within specified range.
- C. Ballast: Large aggregate either placed with voids subsequently filled with flowable fill injected by grouting method; or in areas with open access, placed individually and sequentially at same time as flowable fill placement.
- D. Backgrouting: Secondary stage pressure grouting to ensure that voids have been filled within the abandoned sanitary sewer. Backgrouting shall only be required at critical locations indicated on the Drawings or if there is evidence of incomplete flowable fill placements.

1.4 REFERENCES

- A. ASTM – American Society for Testing and Materials.
 - 1. ASTM C150 – Standard Specification for Portland Cement.
 - 2. ASTM C494 – Standard Specification for Chemical Admixture for Concrete.
 - 3. ASTM C937 – Standard Specification for Grout Fluidifier for Pre-placed Aggregate Concrete.
 - 4. ASTM C940 – Standard Test Method for Expansion and Bleeding of Freshly Mixed Grout for Replaced Aggregate Concrete in the Laboratory.
 - 5. ASTM C1017 – Standard Specification for Chemical Admixture for Use in Producing Flowing Concrete.
 - 6. ASTM C1107 – Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
- B. CFTS – City of Friendswood Technical Standards.

1.5 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Flowable fill mix design report:
 - 1. Flowable fill type and production method. Describe if fill shall be mixed to final proportions and consistency in batch plant or if constituents shall be added in transit mixer at placement location.
 - 2. Use of ballast: Provide percentage of ballast of total placement and size limits for ballast if fill is intended to be used with ballast.

3. Aggregate gradation of fill: Aggregate gradation of mix (excluding ballast) shall be used as pilot curve for quality control during production.
 4. Fill mix constituents and proportions including materials by weight and volume and air content but excluding ballast. Give types and amounts of admixtures including air entrainment or air generating compounds.
 5. Fill densities and viscosities, including wet density at point of placement.
 6. Initial time of set.
 7. Bleeding and shrinkage.
 8. Compressive strength.
- C. Technical information for equipment and operational procedures including projected slurry injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design and number of stages of grout application.
- D. Experience record for proposed crew, showing minimum of one hundred cubic yards (100 Cy) of flowable fill placed using proposed or similar equipment and methods.
- E. At least sixty days (60 D) prior to commencing abandonment activities, submit plan for abandonment, describing proposed grouting sequence, bypass pumping requirements and plugging, if any and other information pertinent to completion of the Work.

PART II: PRODUCTS

2.1 FLOWABLE FILL

- A. Design Mix Criteria: Provide design of one (1) or more mixes to meet design criteria and conditions for placement. Present information required by Paragraph 1.5.B in mix design report including following:
1. Cement: ASTM C150 Type I or II. Volume and weight per cubic yard of fill. Provide minimum cement content of one hundred pounds per cubic yard (100 Lbs/Cy).
 2. Potable water: Volume and weight per cubic yard of fill. Amount of water determined by mix design testing.
 3. Aggregate gradation: One hundred percent (100%) passing three-eighths inch (3/8 In) sieve and not more than ten percent (10%) passing No. 200 sieve. Mix design report shall define pilot gradation based on following sieve sizes three-eighths inch (3/8 In), Nos. 4, 8, 16, 30, 50, 100 and 200. Do not deviate from pilot gradation by more than plus or minus ten percentage ($\pm 10\%$) points for any sieve for production material.
 4. Aggregate source material: Screened or crushed aggregate, pit or bank run fine gravels or sand or crushed concrete. If crushed concrete is used, add at least thirty percent (30%) of natural

- aggregate to provide workability.
- 5. Admixtures: Use admixtures meeting ASTM C494 and ASTM C1017 as needed to improve pumpability, to control time of set and reduce bleeding.
- 6. Fluidifier: Use fluidifier meeting ASTM C937 as necessary to hold solid constituents in suspension. Add shrinkage compensator if necessary.
- 7. Performance additive: Use flowable fill performance additive, such as Darafill or approved equal, to control fill properties.
- B. Flowable Fill Requirements:
 - 1. Unconfined compressive strength: minimum seventy-five pounds per square inch (75 psi) and maximum one hundred fifty pounds per square inch (150 psi) at fifty-six days (56 D) as determined based on an average of three (3) tests for same placement. Present at least three (3) acceptable strength tests for proposed mix design in mix design report.
 - 2. Placement characteristics: self-leveling.
 - 3. Shrinkage characteristics: non-shrink.
 - 4. Water bleeding for fill to be placed by grouting method in sanitary sewers: not to exceed two percent (2%) according to ASTM C940.
 - 5. Minimum wet density: ninety pounds per cubic foot (90 Lbs/Cf).

2.2 BALLAST

- A. Ballast Material: Natural rock or concrete pieces within the following limits:
 - 1. Minimum size equal to at least ten (10) times maximum aggregate size of flowable fill and;
 - 2. not more than twenty percent (20%) of minimum dimension of space to be filled and;
 - 3. maximum size of twenty-four inches (24 In).
- B. Ballast Composition: Free of regulated waste material.

2.3 PLUGS FOR SANITARY SEWER FORCE MAINS

- A. Grout Plugs: Cement-based dry-pack grout conforming to ASTM C1107, Grade B or C.
- B. Manufactured Plug: Commercially available plug or cap specifically designed and manufactured to be used with pipe being abandoned.

PART III: EXECUTION

3.1 PREPARATION

- A. Have fill mix design reports and other submittals required by Paragraph 1.5 accepted by the Project Manager prior to start of placement. Notify the Project Manager at least twenty-four hours (24 Hrs) in advance of

- grouting with flowable fill.
- B. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at pressure that shall not distort or imperil portion of the Work, new or existing.
- C. Clean sanitary sewer lines and video with closed circuit television to identify connections, locate obstructions and assess condition of pipe. Locate previously unidentified connections, which have not been redirected and reconnected as part of this project and report them to the Project Manager. During placement of fill, compensate for irregularities in sanitary sewer lines, such as obstructions, open joints or broken pipe to ensure no voids remain unfilled.
- D. Perform demolition work prior to starting placement of fill. Clean placement areas of sanitary sewers and manholes of debris that may hinder fill placement. Remove excessive amounts of sludge and other substances that may degrade performance of fill. Do not leave sludge or other debris in place if filling more than two percent (2%) of placement volume. Dispose of waste material in compliance with Section 01580 – Waste Material Disposal.
- E. Remove free water prior to starting fill placement.

3.2 EQUIPMENT

- A. Mix flowable fill in automated batch plant and deliver it to site in ready-mix trucks. Performance additives may be added at placement site if required by mix design.
- B. Use concrete or grout pumps capable of continuous delivery at planned placement rate.

3.3 DEMOLITION OF SANITARY SEWER MANHOLES, PIPELINE STRUCTURES AND SANITARY SEWER FORCE MAINS PRIOR TO ABANDONMENT

- A. Remove manhole frames and covers and castings from other existing sanitary sewer structures. Deliver castings to the City of Friendswood Public Works Facility for future use. Alternatively, salvaged castings may be used upon approval by the Project Manager for use in construction of new manholes on the project.
- B. Demolish and remove precast concrete adjustment rings and corner section or brick and mortar corbel and chimney or other sanitary sewer structures, to minimum depth of four feet (4 Ft) below finished grade. Structures may be removed to greater depth, but not deeper than eighteen inches (18 In) above crown of abandoned sanitary sewer.
- C. When adjacent sanitary sewer lines are not to be filled, place temporary plugs in each line connecting to manhole, in preparation for filling manhole.
- D. Excavate overburden from sanitary sewer force mains to be abandoned at locations indicated on the Drawings, conforming to Section 02125 –

Excavation and Backfill for Utilities. Cut existing sanitary sewer force main, when necessary, to provide an end surface perpendicular to axis of pipe and suitable for plug to be installed. Remove sanitary sewer force main piping material remaining outside of segment to be abandoned.

3.4 INSTALLATION

- A. Abandon sanitary sewer lines by completely filling sanitary sewer line with flowable fill. Abandon manholes and other structures by filling with flowable fill, together with ballast as applicable, within depth of structures left in place.
- B. Place flowable fill to fill volume between manholes. Continuously place flowable fill from manhole to manhole with no intermediate pour points but in no case exceeding five hundred feet (500 Ft) in length unless approved by the Project Manager.
- C. Have filling operation performed by experienced crews with equipment to monitor density of flowable fill and to control pressure.
- D. Temporarily plug sanitary sewer lines which are to remain in operation during pouring/pumping to keep lines free of flowable fill.
- E. Pump flowable fill through bulkheads constructed for placement of two (2) – two inch (2 In) PVC pipes or use other suitable construction methods to contain flowable fill in lines to be abandoned. These pipes shall act as injection points or vents for placement of flowable fill.
- F. Place flowable fill under pressure flow conditions into properly vented open system until flowable fill emerges from vent pipes. Pump flowable fill with sufficient pressure to overcome friction and to fill sanitary sewer from downstream end, to discharge at upstream end.
- G. Inject flowable fill through replaced ballast using grouting equipment and series of grout pipes discharging at bottom of placement, allowing fill to rise through ballast effectively filling all voids. Alternatively, sequentially place individual pieces of ballast at same time as flowable fill is placed. Do not fill with ballast more than fifty percent (50%) of volume at any level, to prevent nesting and void formation.
- H. Remediate placement of flowable fill which does not fill voids in sanitary sewer, in manholes or in other structures, or where voids develop due to excessive shrinkage or bleeding of fill, by using pressure grouting either from inside sanitary sewer or from surface. Pressure grout shall conform to Section 03105 – Grout.
- I. Plug each end of sanitary sewer force main being abandoned.
- J. Sanitary sewer force main abandonment:
 - 1. Clean inside surface of sanitary sewer force main at least twelve inches (12 In) from ends to achieve firm bond and seal grout plug or manufactured plug to pipe surface. Similarly, clean and prepare exterior pipe surface if manufactured cap is to be used.
 - 2. When using grout plug, place temporary plug or bulkhead approximately twelve inches (12 In) inside pipe. Fill pipe end completely with dry-pack grout mixture.

3. When using manufactured plug or cap, install fitting as recommended by manufacture's instructions, to form water tight seal.
- K. Backfill to surface, above pipe or structures left in place, with:
 1. flowable fill in restricted areas or;
 2. compacted bank run sand in unrestricted areas to be paved or;
 3. select fill in unrestricted areas outside of pavement.
- L. Place and compact backfill, other than flowable fill, in compliance with Section 02125 – Excavation and Backfill for Utilities.
- M. Collect and dispose of excess flowable fill material and other debris in accordance with Section 01580 – Waste Material Disposal.

3.5 FIELD QUALITY CONTROL

- A. Provide batch plant tickets for each truck delivery of flowable fill. Note on tickets addition of admixtures at site.
- B. Check flow characteristics and workability of fill as placement proceeds.
- C. Obtain at least three (3) test cylinders for each placement area for determination of fifty-six day (56 D) compressive strength and bleeding. Acceptance of placement shall be based on average strength of three (3) tests.
- D. Record volume of ballast together with flowable fill placement for same space to demonstrate that voids have been filled.

3.6 PROTECTION OF PERSONS AND PROPERTY

- A. Provide safe working conditions for employees throughout demolition and removal operations. Observe safety requirements for work below grade.
- B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to the Work.

END OF SECTION

SECTION 02530 SANITARY SEWER LINE CLEANING

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Cleaning of Sanitary Sewer Lines to include all the equipment, labor and materials necessary to perform all work for sewer line cleaning.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment shall be made for acceptance testing under this Section. Include payment in the unit price for work requiring acceptance testing.
 - 2. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

- A. CFTS – City of Friendswood Technical Specifications.
- B. TCEQ – Texas Commission on Environmental Quality.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures.
- B. The Contractor shall submit all manufacturer's brochures and specifications for the cleaning equipment.
- C. Methods of cleaning and clearing lines shall submit for review and approval by the Project Manager.

1.5 QUALITY ASSURANCE

- A. The Contractor shall comply with all codes, laws, ordinances and regulations of the governmental authorities having jurisdiction over this work.
- B. The Contractor shall comply with the latest revision of the Occupational Safety and Health Administration manuals for construction and confined spaces.
- C. The Contractor shall comply with all rules and regulations of the Texas Commission on Environmental Quality.
- D. The sanitary sewer line cleaning shall remove foreign materials from the lines and restore the sanitary sewer to a minimum of ninety-five percent (95%) of the original carrying capacity or as required for proper seating of an internal pipe line. It is recognized that there are some conditions such as broken pipe and major blockages that prevent cleaning from

being accomplished or where additional damage would result if cleaning were attempted or continued. Should such conditions be encountered, the Contractor shall immediately notify the Project Manager and the Contractor shall not be required to clean that section of pipe.

1.6 COORDINATION

- A. The Contractor shall completely remove and dispose of all dirt, rubbish and surplus, and unsuitable materials at the end of each work day at no additional cost to the City and in accordance of Section 01580 – Waste Material Disposal.
- B. The Contractor shall be allowed to use the City water supply for filling the tanks. The Contractor shall go to the Public Works Department and obtain, by leaving a deposit, a meter for fire hydrants. There shall be no charge for the water used during this operation. There shall be either an RPZ or and an air gap for filling of the tanks. All filling operations are to be reviewed by the Project Manager.

PART II: PRODUCTS

2.1 HIGH VELOCITY JET (HYDRO CLEANING) EQUIPMENT

- A. All high-velocity sanitary sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two (2) or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from fifteen degrees (15°) to forty-five degrees (45°) in all sizes of pipe designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floors. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps, hydraulically driven hose reel and recovery tank.
 - 1. The equipment shall have a minimum of six hundred feet (600 Ft) of one inch (1 In) I.D. high pressure hose.
 - 2. The nozzles shall have a capacity of sixty gallons per minute (60 GPM).
 - 3. The minimum working pressure shall be one thousand pounds per square inch (1000 psi).

PART III: EXECUTION

3.1 CLEANING PRECAUTIONS

- A. During sanitary sewer cleaning operations, satisfactory precautions shall be taken in the use of the cleaning equipment to insure that the water pressure does not create damage or cause flooding of property or buildings being served by the sewer. Extraordinary care shall be taken to prevent the nozzle from causing damage to people, vehicles or other

property that are in the vicinity of or around the equipment.

3.2 SEWER LINE CLEANING

- A. The designated sanitary sewer sections shall be cleaned using high-velocity jet equipment. The equipment shall be capable of removing roots, dirt, grease, sand, rocks and other materials and obstructions from sanitary sewer lines and manholes. There shall be a debris catcher on the downstream manhole if the system is currently tied into the City's existing sanitary sewer system. If cleaning of an entire section cannot be successfully performed from one (1) manhole, the equipment shall be set up on the other manhole and cleaning again attempted. If again successful cleaning cannot be performed or the equipment fails to transverse the entire section, it shall be assumed that a major blockage exists and the cleaning effort shall be abandoned after notification to and approval by the Project Manager.

3.3 ROOT REMOVAL

- A. Roots shall be removed in the sections where root intrusion is a problem. Special attention shall be used during the cleaning operation to assure almost complete removal of roots from the joints. Roots which could prevent installation of a pipe liner shall be removed. Procedures may include the use of mechanical equipment such as rodding machines, bucket machines and winches using root cutters and "porcupines", and equipment such as high-velocity jet cleaners.

3.4 MATERIAL REMOVAL

- A. Sludge, dirt, rocks, sand, grease, roots and other solid or semi-solid material resulting from cleaning operation shall be captured and removed at the downstream manhole of the section being cleaned, loaded in a suitable container, transported to the nearest wastewater treatment facility and disposed of at that facility in accordance with all requirements and charges and as specified in Section 01580 – Waste Material Disposal.
- B. **UNDER NO CIRCUMSTANCES SHALL SEWAGE OR SOLIDS OR ANY OTHER TYPE OF WASTE MATERIAL FROM THIS OPERATION THAT HAS BEEN REMOVED FROM THE CITY SEWER SYSTEM, BE DUMPED ONTO STREETS OR INTO DITCHES, CATCH BASINS, STORM DRAINS, EXISTING SANITARY SEWER MANHOLES, ON THE GROUND OR INTO STREAMS.**

3.5 CLEANING WATER DISPOSAL

- A. Water used to clean the sewer lines shall be discharged into the sanitary sewer system downstream of the cleaning operation or as otherwise directed by the Project Manager.
- B. **UNDER NO CIRCUMSTANCES SHALL THE CONTRACTOR DISCHARGE WATER USED TO CLEAN THE SEWER LINES ONTO**

**STREETS OR INTO DITCHES, CATCH BASINS, STORM DRAINS,
EXISTING SANITARY SEWER MANHOLES, ON THE GROUND OR
INTO STREAMS.**

3.7 FINAL ACCEPTANCE

- A. Acceptance of sanitary sewer line cleaning shall be made upon completion of the television inspection as specified in Section 02520 – Television Inspection of Sanitary Sewer Lines. The DVD media and reports shall be reviewed and approved by the Project Manager. Any television inspection that shows the cleaning to be unsatisfactory shall require the process of re-cleaning and re-inspecting to be repeated until the sanitary sewer line cleaning is satisfactory to the Project Manager. Re-cleaning and re-inspection shall be done at no additional cost to the City.

END OF SECTION

**SECTION 02535
SANITARY SEWER LIFT STATIONS**

PART 1: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Installation of permanent, replacement and temporary sanitary sewer lift stations and equipment.
- B. This Technical Specification is intended as a general description of sanitary sewer lift station requirements and does not purport to describe all details of the equipment to be furnished. See the individual Sections for detailed specifications on equipment.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for sanitary sewer lift station components shall be broken down into a schedule of values and shall be paid according to the percentage finished of each value.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

- A. ASTM – American Society for Testing and Materials.
 - 1. ASTM C443 Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 - 2. ASTM C478 Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - 3. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 4. ASTM D3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 5. ASTM D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
- B. AWWA – American Water Works Association.
 - 1. AWWA C151 – Standard Pressure Classes – Wall thickness and nominal wall thickness.
 - 2. AWWA C500 – Metal-seated Gate Valves for Water Service.
 - 3. AWWA C508 – Swing-Check Valves for Waterworks Service, 2 in. through 24 in. NPS
 - 4. AWWA C509 – Resilient-Seated Gate Valves for Water Service.

- 5. AWWA C550 – ERTA Protective Interior Coatings for Valves and Hydrants.
- C. CFTS – City of Friendswood Technical Specifications.
- D. NEC – National Electrical Code.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit product data for each type of pipe and equipment that shall be incorporated in the Work.

1.5 QUALITY ASSURANCE

- A. The Project Manager shall be responsible for the day to day inspection of the Work and overall quality inspection. The City's Building Division shall be responsible for verifying the Contractor has complied with all Federal, State and City Codes, Regulations and Ordinances.
- B. In matters of building codes, the Building Inspector shall govern over all aspects. The Chief Building Official shall be the final determining authority over matters or questions on codes, ordinances and regulations.
- C. The Contractor shall comply with the start up procedure as stated in paragraph 3.11 in this Section.

PART 2: PRODUCTS

2.1 WET WELLS

- A. The wet well shall consist of a circular basin a minimum of seven feet (7 Ft) in diameter and a minimum of ten feet (10 Ft) in depth. The wet well shall be constructed of reinforced concrete meeting the requirements of Section 03300 – Structural Concrete. The wet well walls shall be designed to withstand the external earth loadings when wet well is empty.
 - 1. Precast wet wells shall be installed according to Section 02305 – Precast Concrete Manholes. Materials for Precast sections shall conform to ASTM C478 and cylinders shall be joined by watertight gasketed joints per ASTM C443.
 - 2. The base wet well shall consist of a minimum of twelve inches (12 In) of reinforced concrete. The base shall be installed on top of a seal slab with the thickness as shown on the Drawings.
 - 3. All pipe openings shall be core drilled into the wet well walls.
 - 4. All openings and base slab shall be sealed with a non-shrink grout meeting the specifications of Section 03105 – Grout.
 - 5. All wet wells shall be coated with Raven or Spectrashield.
- B. Air Vent: The wet well shall have a minimum three inch (3 In) diameter ductile iron or stainless steel air vent extending through the top slab

- with a one hundred eighty degree (180°) turn sealed by an approved insect screen.
- C. Guide Rails: Provide type 304 stainless steel pump guide rails, two (2) per pump, in the wet well securely fastened to the top opening of the wet well to allow the pumps to accurately mate with the pump bases which shall be secured to the bottom with stainless steel bolts.
 - D. Pump Bases: Pump bases shall be as specified by the manufacturer and approved by the Project Manager. Bases shall have a minimum four inch (4 In) ductile iron (Class 200) discharge pipe. Pumps shall be provided with a stainless steel lifting chain capable of raising the pumps to the top slab.
 - E. Floats: Floats for control of the pumps and alarms shall be provided by the pump manufacturer and shall be installed so as that they are not affected by incoming flow.
 - F. Access Hatch: Access to the wet well shall be through a rectangular aluminum hatch with 316 stainless steel hardware and rated for a three hundred pound (300 Lb) load, and of a size which provides the maximum size opening required for work in the wet well. The top of the hatch shall be a minimum of twelve inches (12 In) higher than the surrounding area. The finish shall be either checkered, diamond plate or other approved non-slip surface. Hatch shall open and lock automatically with stainless steel "hold open" arm with aluminum release handles.
 - G. Ladder: Human access to the wet well will not normally be required but steps shall be provided and embedded in the wet well. Rungs shall have sixteen inch (16 In) spacing. Ladder and all hardware shall be stainless steel.
 - H. Discharge connection elbows shall be permanently installed in the wet well.

2.2 PUMPS AND MOTORS

- A. Pumps for installation in sanitary sewer lift stations shall be Flygt with dual guide rail systems. No exceptions.
- B. The pump and motor units shall be the submersible type designed to pump raw sewage through a minimum four inch (4 In) discharge force main. All nuts, bolts, washers and other fastening devices coming into contact with raw sewage shall be constructed of Type 304 stainless steel.
- C. Pumps shall have single or double shrouded, balanced, non-clogging impellers and shall be capable of handling solids, fibrous materials heavy sludge and shall be capable of passing three inch (3 In) diameter spheres. Pumps shall be driven by three phase (3 Ø), four hundred sixty volt (460V), sixty hertz (60 Hz) motors.
- D. Pump motors shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled or oil field watertight chamber, NEMA B type. The pump power cable shall be sized according to the

NEC standards and shall be oil resistant chloroprene rubber. Motor and cable shall be capable of continuous submergence without loss of watertight integrity to a depth of sixty-five feet (65 Ft).

- E. Hydraulic Sealing Flange: Pumps shall be supplied with a universal coupling which bolts to the pump discharge and shall accept the discharge elbow provided by the manufacturer. Seal of the pump discharge flange shall be accomplished by a simple downward motion of the pump with the entire weight of the pump guided to and pressing against the discharge connection; no part of the pump shall bear directly on the sump floor and no rotary motion of the pump shall be required for sealing. Sealing at discharge shall be affected directly by a rubber lip to ensure a positive leak proof system and for ease of removal.

2.3 PIPING AND VALVING

- A. All piping and fittings in the wet well shall be ductile iron, class 260 in accordance with AWWA C151. The connection outside shall be made with a ductile iron mechanical joint solid sleeve.
- B. Gate Valves: Gate valves shall be in accordance with AWWA C500 and AWWA C509 and have hand wheel operators. All valves shall be open left (counter-clockwise)
- C. Swing Check Valves: Check valves shall have exterior weighted arms and conform to AWWA C508. Valves shall be cast iron body with bronze mounted, single disc, one hundred seventy-five pounds per square inch (175 psi) working pressure, and cushioned closing type. Valve shall be coated in accordance of AWWA C550. Check valves shall be air cushioned, horizontal swing bolted bonnet, removable seat and disc flanged. A stainless steel pressure gauge shall be installed on the upstream side of the check valve.
- D. Surge Relief Valves: Force mains with a total dynamic head greater than eighty feet (80 Ft) shall be required to have a surge relief valve.

2.4 STORAGE CAPACITY

- A. The sanitary sewer lift station shall have additional storage capacity to handle flows at peak demand period, during a power failure or other malfunction, of at least two hours (2 Hrs).

2.5 PAVING

- A. All paving and areas around the lift station shall have a minimum of eight inches (8 In) stabilized subgrade and seven inches (7 In) of concrete. Driveway shall have a minimum width of fourteen feet (14 Ft).
 - 1. Subgrade: Excavate and proof roll natural ground and remove any soft spots. Install eight inches (8 In) of stabilized subgrade and compact to ninety-five percent (95%) Standard Proctor.

2. Place seven inches (7 In) of concrete in accordance with Section 03300 – Structural Concrete.

2.6 FENCING

- A. Install eight foot (8 Ft) high opaque wood fence around perimeter of the sanitary sewer lift station with a mow strip. This fence shall be level across the top for the perimeter of the lift station and/or property line. Refer to Section 02930 - Cedar Fence for more details.

2.7 ELECTRICAL COMPONENTS AND CONTROLS

- A. The electrical, control and alarm system shall be as specified in the Division sixteen (16) of these specifications and installed in accordance with the National Electrical Code. The complete system shall be furnished and installed by one (1) supplier. The Contractor shall call the local power distribution company and install all lines to the control panel and meter in accordance of their requirements. The electric meter shall be installed as close to the lift station as allowed by the local power distribution company. Electrical equipment as listed below are the basics, and all details would need to be reviewed on the Drawings and Division sixteen (16) – ELECTRICAL.
 1. Enclosures, Power Distribution Blocks, Surge suppression, Circuit Breakers, Contactors, Relays, Transformers, time delays, and Fuses.
 2. Alarm light, Alarm system and SCADA Monitoring System.
 3. SCADA system shall conform and be compatible with current City of Friendswood SCADA system.

PART 3: EXECUTION

3.1 GENERAL

- A. The work covered by this Section of the Technical Specifications shall consist of furnishing all specified materials with all necessary equipment, machinery, tools and labor and performing all work required to install and/or construct the sanitary sewer lift stations, incorporating all change orders, directives and modifications, all to shall be complete, in place, accepted and ready for use. Failure to comply with these Technical Specifications will result in the rejection of the Work by the Project Manager.

3.2 STRUCTURES

- A. All structures such as the wet well and the control panel base shall be constructed as detailed on the Drawings and as directed in these Technical Specifications. All access frames and covers shall be properly set and installed as recommended by the manufacturer.

3.3 PUMP AND MOTOR INSTALLATION

- A. The pump and motor units shall be carefully installed as recommended by the manufacturer and the seals between pumps and pump bases must mate as intended. The pump and motor shall be properly wired and field checked to see that it can easily be removed and replaced by means of lifting the chains and do not bind on the guardrails. Actual pump tests shall be required by placing water in the wet well and timing the withdrawal rates.

3.4 ELECTRICAL AND CONTROLS

- A. Permanent power shall be installed and all systems operating checked and verified. All electrical equipment, wiring and devices shall be installed in accordance with the National Electrical Code and shall be inspected by the City of Friendswood Building Division.

3.5 PIPING

- A. Piping shall be installed as shown on the Drawings and in accordance with all relevant Technical Specifications.

3.6 PAVING

- A. Paving shall be provided for the access road and for all areas inside the fence and shall consist of materials as specified in this Section. Paving shall be smooth grade and sloped to provide proper drainage, especially away from the lift station facilities. All paving shall have a light to medium broom finish and shall have been treated with curing compound.

3.7 FENCING

- A. Fencing and access gates shall be installed as shown on the Drawings and as approved by the Project Manager using the materials stated in this Section.

3.8 TESTING

- A. Testing shall consist of verification on all piping and wet wells that there is no infiltration. All backfill and subgrade shall be tested as required. Independent Testing Laboratory shall be contracted by the City.

3.9 SITE CLEANUP, RESTORATION AND GRADING

- A. After the Work has been completed, the Contractor shall clear the site of all construction materials and other debris. Grading shall consist of providing proper drainage and all sites shall be left in a neat, clean and acceptable condition. All property that has been disturbed by or during the Work, shall be restored to a condition that is equal to, or better than, the condition before the Work was started. In any existing or proposed lawn areas, the final restoration shall include sodding.

3.10 OPERATION AND MAINTENANCE MANUALS AND RECORD DRAWINGS

- A. The Contractor shall supply two (2) sets each of Operation Manuals and Maintenance Manuals. Only one (1) copy of the original manufacturers' data sheets for miscellaneous components shall be required. City staff shall be instructed on the operation and maintenance of all equipment installed at the lift station.
- B. Record Drawings and documents shall consist of all revised Drawings, all Contract Documents and the As-Built for the Work. The as-builts shall be rendered to the City on a CD in an acceptable AutoCAD format to be verified by the Project Manager. All Mylars used for the production of the Drawings shall become the property of the City.

3.11 START UP PROCEDURE

- A. After the verification of completed substantial completion punch items, a final walkthrough shall be scheduled to include the Director of Public Works, the Water/Wastewater Superintendent, the Project Manager, the Contractor and all Subcontractors necessary for the startup procedures. The Contractor shall perform the following start up procedure in the presence of the City personnel.
 - 1. Have wet well filled with water and a tank standing by. Simulate all conditions so that the floats can control the normal operations of the pumps.
 - 2. Pumps shall be tested for flow rate by attaching a flow test meter to the discharge pipe, and cycling the pump. Flow rate shall have a tolerance of plus or minus ten percent ($\pm 10\%$).
 - 3. Simulate all conditions likely to be encountered during normal operations including, but not limited to, running pumps in manual, setting off causes for alarm and verifying the dialer program is working.
 - 4. Verify that SCADA system is online and working. This also includes communications with current SCADA system.
- B. If any of the tests fails or does not perform to specifications or expectations the Project Manager shall reject the Work as being unacceptable and incomplete for final acceptance. The Contractor shall make any and all necessary repairs to bring the lift station to final completion. The Contractor shall schedule and perform a new start-up procedure at no extra cost to the City.

END OF SECTION

Section 02555

SANITARY SEWER BYPASS PUMPING

1.0 GENERAL

1.01 SECTION INCLUDES

- A. Bypass-pumping: Installation of bulkheads, plugs, hoses, piping, and pumps required to maintain sewer flow and prevent backups and overflows.
- B. References to Technical Specifications:
 - 1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.

1.02 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be on a lump sum basis.
- B. Payment shall be for a complete-in-place pumping system and include all equipment, labor, and materials to complete the Work. This shall include, but not be limited to, installation of plugs, pumping equipment, pipes, hoses, valves, fittings, level transducers, emergency provisions, communications, fuel, system maintenance throughout pumping duration, disassembly and removal from the site, and clean-up.
- C. Refer to Section 01200 – Measurement and Payment Procedures

1.03 SYSTEM DESCRIPTION

- A. Provides continuous sewer service to users of sewer systems while maintenance or construction operations are in progress, by diverting flow around construction locations. Maintain sewer flow to prevent backup or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways. Do not divert sewage outside of sanitary sewer system.
- B. When pumps are operating, have an experienced operator on site to monitor operation, adjust pumps, make minor repairs to system, and report problems.
- C. Contractor must use jointless (fusible) HDPE pipe designed to withstand the pressures for bypass pumping. The Contractor must have one (1) additional standby pump available on the job site for bypass pumping in the event of failure of any pumps. The Contractor is responsible for submitting a plan of action to the Owner and the Engineer for review and concurrence, showing the layout of the proposed bypass system with working hours, and any other information that would be needed to accommodate the proposed construction. Any changes recommended to accommodate field conditions must be incorporated by the Contractor at no additional cost to the Project.
- D. Contractor is made aware that work will be near residential areas and quiet pumps must be utilized to keep noise levels to a minimum. The pump noise level must not exceed City of Friendswood Ordinances. In the event the Contractor cannot keep the noise level to a minimum, Contractor must utilize electric powered pumps or install soundproof wall barriers around the pumps. The Contractor will replace the

pumps or install soundproof wall barriers at no additional cost to the project.

- E. The existing Lift Station #2 wet well has one (1) incoming 36-inch gravity wastewater line. Flow may not be diverted away from the lift station; therefore, the bypass pumping system must be capable of pumping the firm capacity of the lift station, at a minimum (approximately 7,700 gpm peak).
- F. Contractor is made aware the Lift Station #2 force main manifolds with the Lift Station #22 force main. Coordination with Public Work is required as Lift Station #22 may need to be temporarily shut-down in order to facilitate temporary bypass or permanent connections to the force main.

1.04 SUBMITTALS

- A. Conform to requirements of Section 01350 - Submittals.
- B. Contractor shall submit a Bypass Pumping Plan prior to installation.
- C. Installation of equipment without Owner and Engineer concurrence is done solely at the Contractor's risk, and may be required to be removed or changed at no separate pay.
- D. Include the following in the Bypass Pumping Plan:
 - 1. Number, size, and location of pumping equipment.
 - a. *Note: one (1) additional standby pump is required to be connected to the system and used immediately in case of another pump failure. Backup unit shall be the same size as the largest pumping unit.*
 - 2. Pump manufacturer and model.
 - 3. Rated horsepower.
 - 4. Selected impeller.
 - 5. Flow rate and pump curve with the lift station peak flow illustrated on the curve.
 - 6. Schematic exhibit showing size, length, alignment, and material of pipe.
 - 7. Manufacturer data for isolation valves, check valves, fittings, and other appurtenances used.
 - 8. Levels and controls with autodialer. Coordinate with City of Friendswood Engineering and Public Works to have City staff added to call list.
 - 9. Connection to force main with types of fittings used.
 - 10. Emergency action and clean-up plan for spills.
 - 11. Sequencing of subsequent lift station work to be performed under bypass.

1.05 SCHEDULING

- A. When the Contractor operates or maintains bypass pumping in construction areas, coordinate construction activities with Owner's representative.
- B. Cease operation of bypass pumping when approved by Owner's representative.
- C. An operational City coordination meeting shall be scheduled by the Contractor to meet with the Engineer, City of Friendswood Engineering, and City of Friendswood Public Works to discuss the bypass plan and temporary diversions a minimum of 30 days prior to commencing bypass pumping. The Contractor shall facilitate and lead this meeting. Items to be discussed include:
 - a. Review of the Bypass Plan.
 - b. Review of emergency provisions

- c. Contractor's staff to be on-call during normal operation and during an emergency.
- d. Schedule and sequence of work to be completed while the station is on bypass.
- e. Steps and provisions to remove the lift station off bypass and return to service.

2.0 PRODUCTS

2.01 MATERIALS

- A. Design piping, joints and accessories to withstand at least twice maximum system pressure or 50 psi, whichever is greater.
- B. Use self-priming type or submersible diesel pumps, with a working pressure gauge on the discharge. Pumps shall comply with the requirements of City of Friendswood Noise Ordinances.
- C. Isolation valves, check valves, and fittings shall be rated for wastewater use.

3.0 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Install bypass pumping units and perform a system start-up. Test run pumps for a period of 24 hours prior to beginning the work.
- B. During bypass pumping, do not allow sewage to leak, dump, or spill into or onto areas outside of existing sanitary sewer systems.
- C. In the event of an accidental spill or overflow, immediately stop discharge and take action to clean up and disinfect spill. Promptly notify Owner's representative so required reporting can be made to the Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency (EPA).
- D. A maximum 30 minute response time is required by the Contractor to respond to bypass pumping issues while bypass pumping is in place.
- E. Only City of Friendswood Public Works staff shall operate valves and equipment at other lift stations.
- F. Lift Station shall operate on bypass for duration of rehabilitation, as indicated in the Bypass Phasing Plan. Bypass pumping equipment shall not be demobilized or removed from the site until the lift station rehabilitation has been completed, tested, accepted, and has been receiving normal flow.

3.02 CLEANING

- A. When bypass-pumping operations are complete, drain sewage within piping into sanitary sewers prior to disassembly.

END OF SECTION

SECTION 02565 LIFT STATION CLEANING

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. The purpose of Lift Station Cleaning is to remove all debris, grit, and bio-solids from the designated facilities. The contractor may de-water the solid material, and the contractor shall be responsible for the disposal of the wastewater/solid in an approved and regulated manner.
- B. All cleaning operations shall be required to meet OSHA standards, especially if considered a confined space.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for lift station cleaning shall be paid on a per hour basis, for all necessary labor, material, equipment, supervision, and performing all work necessary to clean the wet well, to remove all debris, grit, and grease to provide final wash down of walls and ceilings and fixtures, to dispose of all removed water and solids.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for Work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

- A. ANSI/ASSE – American National Standards Institute/American Society of Safety Engineers.
 - 1. ANSI/ASSE Z117.1-2009 – Safety Requirements for Confined Spaces.
 - 2. ANSI/ASSE Z359.1-2007 – Safety Requirements for Personal Fall Arrest Systems, Subsystems, and Components.
- B. CFTS – City of Friendswood Technical Specifications.
- C. OSHA – Occupational Safety and Health Administration CFR-29 Standards.
 - 1. 1910.23 – Guarding Floor and Wall Openings and Holes.
 - 2. 1910.146 – Permit Required Confined Spaces.
 - 3. 1926, Subpart E – Personal Protective and Life Saving Equipment.
 - 4. 1926, Subpart M – Fall Protection.
- D. TCEQ – Texas Commission on Environmental Quality.

PART II: PRODUCTS – NOT USED

PART III: EXECUTION

3.1 CLEANING, MINOR

- A. Skimming of all debris, trash, sludge and other materials floating on top of the liquids in the wet well.
- B. All material removed from the wet well shall be disposed of in accordance with TCEQ rules and regulations, latest edition.

3.2 CLEANING, MAJOR

- A. The wet well shall be pumped down as far as possible with existing pumps. Cleaning of facilities shall include cleaning of sloped floor, walls, connected piping, and channels.
- B. Remove all grease from wet well surfaces, including flow level floats and monitors. Contractor shall also remove all grease floating or in mats.
- C. All sludge, grit, grease, scum, and other debris shall be completely removed and disposed of in accordance with TCEQ specifications.
- D. All existing concrete, piping, and equipment shall be cleaned with high-pressure water.
- E. There are no claims as to the condition, hardness, or type of material to be removed.
- F. After the removal of the grit and sludge, the wet well shall be inspected.
- G. Contractor shall take precautions not to damage (further) the existing equipment in the lift stations wet well. Contractor shall be responsible for any careless damage and shall be responsible for any repairs to damaged facilities.

3.3 DEWATERING AND DISPOSAL

- A. Existing material may be taken from the wet well and hauled directly for disposal, or solids and debris may be dewatered onsite. The dewatering process shall not create odors or vector problems. Grease shall be removed directly and not dewatered. Dissolved grease may not be put back into the bypass pumping. All dewatering and disposal operations shall be done in compliance with the latest TCEQ Regulations.

3.4 SOLIDS DISPOSAL

- A. Disposal of grit and sludge shall be in accordance with State, Federal, and Local regulations and is the responsibility of the Contractor. Contractor shall be responsible for cleaning up any material spills in accordance with State, Federal, and local regulations. The contractor shall submit information on the disposal of material. The landfill shall be

identified on the manifest for official records. The vendor shall not stockpile any removed material on site. Contractor shall be required to meet State and City regulations for sludge/liquid transportation.

- B. Compensation for transportation and disposal of waste material resulting from cleaning and inspection operations is considered subsidiary to the cost of cleaning and inspection. Additional compensation shall not be allowed.

3.5 CONFINED SPACES

- A. The work contemplated under this project involves activities in and around confined spaces. The contractor and/or contractors independently retained employee or safety consultant shall implement a confined space entry program in accordance with OSHA Standards governing the presence and activities associated with working in and around confined spaces. The contractor shall, as a function of the Health and Safety plan implement a confined space entry program. The contractor shall maintain a copy of the Confined Space Entry Program on site at all times. The contractor shall take all necessary actions to ensure that his employees and employees of any sub contractor have read and understand and follow the plan.
- B. The contractor shall implement OSHA Fall Protection around any openings.

END OF SECTION

SECTION 02566 SUBMERSIBLE WASTEWATER PUMPS

PART I: GENERAL

1.1 SCOPE OF WORK

- A. The work in this section shall include furnishing and placing into operation 2 submersible pumps, with discharge connections, lifting chains, and guide bars as specified herein and as indicated on the drawings. The complete pump station shall be submersible up to 65 feet above the inlet pipe level.

1.2 RELATED SECTIONS

- A. Section 16420 Motor Controllers

1.3 REFERENCES

- A. American Society for testing and material (ASTM) International
 - 1. A 48: Standard Specification for Gray Iron Castings.
 - 2. A743: Standard Specification Iron-Chromium Nickel, Corrosion Resistant
- B. American National Standards Institute (ANSI):
 - 1. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.
- C. Hydraulic Institute: Current Standards.
 - 1. HI 14.6: Hydrodynamic Pumps for Hydraulic Performance Acceptance Tests.
 - 2. HI 11.6: Submersible Pump Tests

1.4 SUBMITTALS

- A. Submittal data shall be provided to show compliance with these specifications, plans or other specifications that will influence the proper operation of the pump(s).
- B. Standard submittal data for approval must consist of:
 - 1. Pump Performance Curves.
 - 2. Pump Outline Drawing.
 - 3. Station Drawing for Accessories.
 - 4. Electrical Motor Data.
 - 5. Typical Installation Guides.
 - 6. Technical Manuals and Parts List.
 - 7. Printed Warranty.
 - 8. Management system certificate ISO 9001.
 - 9. Manufacturer's Equipment Storage Recommendations.
 - 10. Manufacturer's Standard Recommended Start-Up Report Form.
- C. Lack of the above requested submittal data is cause for rejection.

1.5 QUALIFICATION REQUIREMENTS

- A. The manufacturer shall provide data on alternate equipment manufacturer's experience. Only Manufacturers with 20 or more years of experience who have furnished at least 5 similar lift stations shall be considered.
- B. After installation, a pump station start-up shall be performed by the installing contractor under the supervision of the manufacture's authorized representative. 8 hours of field service shall be provided by an authorized, factory trained representative of the pump manufacturer. Services shall include, but not be limited to, inspection of the completed pump station installation to ensure that it has been performed in accordance with the manufacturer's instructions and recommendations, supervision of all field-testing and activation of the Pump Manufacturer's Warranty. The test shall demonstrate to the satisfaction of the Owner that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly without exceeding the full load amperage rating of the motor. The Contractor shall be responsible for coordinating the required field services with the Pump Manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle products to site under provisions of Section 01070 Temporary Facilities and Control.

1.7 OPERATINAL REQUIREMENTS AND WARRANTY

- A. The contractor shall supply and install 2 submersible sewage pumps with discharge connections, discharge pipes, guide bars, and cable holder lifting chains.
- B. The submersible pumps shall have a semi-open multi-vane self-cleaning impeller designed to transport wastewater with fibrous materials like wet wipes.
- C. The impeller shall be wear resistant and made of high chromium cast iron with at least 24% chrome against sand and grit which is expected to enter the pump station with the sewage or the storm water. Impellers that have surface hardening (by thermal, coating, etc.) will not be allowed.
- D. Each pump shall be capable of lifting 1,895 US gpm at a total dynamic head of 55 feet.
- E. The pumps shall be provided with prorated 60 months (5 years) warranty against defects in materials and/or workmanship. Unless otherwise specified, all other equipment shall be warrantied for 12 months (1 year). The warranty shall be in printed form and previously published as the manufacturer's standard warranty for all similar units manufactured, latest revision. Upon warranty occurrence, the manufacturer's authorized service center shall remove, repair, and

reinstall the pump and provide start up on the repaired pump. A detailed failure analysis shall be submitted to the Owner for their records summarizing corrective action taken.

- F. The manufacturer shall guarantee clog-free operation for a period of 24 months from the date of start-up of the pumps by the local authorized factory representative. A certificate shall be provided to the Owner on the day of start up with the local contact information and effective date. If the impeller clogs with typical solids or modern trash debris normally found in domestic wastewater during this period, an authorized representative shall travel to the jobsite, remove the pump, clear the obstruction and reinstall the pump at no cost for the Owner. A written report shall be provided to the Owner detailing the service call with pictures for verification purposes.

PART II: PRODUCTS

2.1 SUBMERSIBLE SEWAGE PUMPS (FLYGT NP 3202, NO SUBSTITUTES)

- A. Each station shall be equipped with 2 submersible, close-coupled wastewater pumps.
- B. Each pump shall be equipped with a 45 HP submersible electric motor, capable of operating on a 460 volt, 3 phases, 60 hertz voltage supply.
- C. The hydraulic of the pump shall be capable of handling raw domestic wastewater and storm water with fibrous materials like wet wipes.
- D. The impeller blades shall be self-cleaning upon each rotation as they pass across a sharp relief groove in the Insert ring and shall keep the impeller blades clear of debris. The insert ring shall have a guide pin which moves fibers from the center of the impeller to the leading edges of the impeller. The impeller shall move axially upwards to allow larger debris to pass through and immediately return to normal operating position. The clearance between the insert ring and the impeller leading edges shall be adjustable.
- E. The impeller shall be wear resistant and made of high chromium cast hard iron with at least 25% chrome against sand and grit which is expected to enter the pump station with the sewage or the storm water.

Impellers that have surface hardening (by thermal, coating, etc.) will not be allowed.

- F. The pump shall be capable of operating without any limitation between 50% and 125% of the Best efficiency point (B.E.P) of the performance curve.

	Flow (US gpm)	TDH (feet)	Hydraulic Efficiency (%)	NPSH _r (ft)
Required Duty Point	1,895	55	64.5	32.7
Guaranteed Duty Point Acc. HI<10kW B	To be filled in by supplier	To be filled in by supplier	To be filled in by supplier	To be filled in by supplier
Best Efficiency Point of Offered Pump (B.E.P.)	To be filled in by supplier	To be filled in by supplier	To be filled in by supplier	To be filled in by supplier

- G. The required shaft power (P2) in the guaranteed duty point shall be less than **40.64 HP**. The motor speed shall be max. : **1,775 rpm**. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output HP and efficiency. This chart shall also include data on starting and no-load characteristics.
- H. The impeller shall be mounted on the motor shaft. Couplings shall not be accepted.
- I. The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. It shall be permanently submersible according to standard IEC 60034 and protection class IP 68.
- J. The stator windings shall be insulated with moisture resistant Class H insulation rated for 356°F.
- K. The motor shall be capable of no less than 30 evenly spaced starts per hour and be able to operate throughout the entire pump performance curve from shut-off through run-out even when the motor is not submerged.
- L. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable.
- M. It shall be possible to lift and lower the pumps on parallel guide bars and connect them to wet well mounted discharge connection. There

shall be no need for personal to enter the wet well when removing or reinstalling the pumps.

- N. The pump housing shall be prepared for the assembling of a sump mixing valve. The discharge flange of the pump housing shall be 6”.
- O. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomeric compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. The motor and the pump shall be produced by the same manufacturer.
- P. The motor shall be able to operate at full load while completely exposed to atmosphere, requiring NO submergence. Motors requiring submergence are not acceptable. The motor shall be protected by 3 thermal switches embedded in the stator set to open at 260°F and one leakage sensor floating type located in the stator chamber. The sensor and the switches shall be connected to the control panel which shall stop the motor and send an alarm when the sensors are activated.
- Q. The pump shall be Explosion approved according FM CLASS 1. DIV 1 "C" & "D".
- R. The cable entry shall consist of dual cylindrical elastomer sleeves, flanked by washers, all having a close tolerance fit against the cable and the cable entry. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.
- S. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated and have a nominal L10 lifetime of 50.000 hours. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.
- T. The shaft shall be sealed by a tandem mechanical shaft seal system consisting of two seals, each having an independent spring system. The seals shall be made of tungsten carbide. Silicon carbide seals are not acceptable. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal function.
- U. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. Seal lubricant shall be non-hazardous.
- V. Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall

protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

- W. PUMP WARRANTY – The pump warranty shall be 5 years from date of commissioning. The pump warranty must include a clog-free guarantee in writing from the manufacturer.
- X. The Materials of construction shall be as follows:
 - 1. Pump housing: ASTM A-48, Class 35B
 - 2. Impeller and insert ring: A 532 ALLOY III A (25% Chrome)
 - 3. Stator housing: ASTM A-48, Class 35B
 - 4. Shaft: ASTM A479 S43100-T.
 - 5. Shaft seal: Pump side: - Corrosion resistant Tungsten carbide WCCR
 - 6. Shaft seal Motor side: - Carbon-Aluminum oxide (AL₂O₃)
- Y. All castings must be blasted before coating. All wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns. Zink dust primer shall not be used.
- Z. The motor shall be equipped with 50 feet of screened cable suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.
- AA. Each completed and assembled pump/motor unit shall undergo the following factory tests at the manufacturer's plant prior to shipment. The Manufacturer shall provide on demand a copy of his quality control plan for these tests and an ISO 9001 factory certificate:
 - 1. Minimum 3-point hydraulic performance test
 - 2. No-Leak seal integrity test
 - 3. Electrical integrity test

2.2 EQUIPMENT FOR WET WELL INSTALLATION

- A. For each pump the contractor shall supply and install a discharge connection made of cast iron ASTM A-48, Class 35B.
- B. The outlet flange of the discharge connection shall be 6" drilled according ANSI B16.1-89; tab.5.
- C. The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two parallel guide bars extending from the top of the station to the wet well mounted discharge

connection. The material of the guide bars shall Stainless steel AISI 316.

- D. The length of the guide bars shall **33.15** feet and they shall be fastened at the top of the station with a guide bar holder made of Stainless steel AISI 316.
- E. For each pump the contractor shall supply and install a cable holder made with 4 hooks of Stainless steel AISI 316.
- F. There shall be no need for personnel to enter the wet-well.
- G. The sealing of the pumping unit to the discharge connection shall be accomplished by machined metal to metal contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be accepted. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.

2.3 LIFTING EQUIPMENT FOR PUMPS

- A. Each pump shall be fitted with 35 feet of stainless steel lifting chain or lifting cable. The working load of the lifting system shall be 50% greater than the pump unit weight.

2.4 SUBMERSIBLE CABLE CONNECTION BOX (INTEX, RALSTON OR SIMILAR)

- A. The submersible cable of the pump shall be connected to the cable from the Control panel in a floor or wall mounted cable connection box to ease the installation and disassembling of the pumps and keep the submersible cables as short as possible.
- B. The cable connection box shall be submersible NEMA 6P (IP 68) to secure that no water can enter the motor via the cables even when the complete area is flooded.

PART III: EXECUTION

3.1 EARTHWORK

- A. Conform to applicable provisions of Section 02125 - Excavation and Backfill for Utilities.

3.2 SETTING VALVES IN MANHOLES AND VAULTS

- A. If required by Engineer, provide services of technical representative of valve manufacturer available on site during installation of valves.
- B. Prior to installing valves, remove foreign matter from within valves. Inspect valves in open and closed position to verify that parts are in satisfactory working condition.
- C. Carefully handle and install valves vertically in such a manner as to prevent damage to any part of the valves. Installation shall be in

accordance with the manufacturer's instructions. Provide nuts, bolts, and gaskets where applicable.

- D. Air valve and gate valve shall be braced adequately to withstand normal pipeline operation pressure and avoid undue stress on the pipe.
- E. Install valves and valve manholes and vaults where indicated on Drawings or by Engineer. Set manholes and vaults plumb and as detailed. Center manholes on valves. Compact cement-stabilized sand around each manhole and vault for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet. Provide above-ground vents for manholes and vaults as indicated on Drawings.

3.3 PAINTING OF PIPING AND VALVES

- A. Paint piping and valves located in manholes, stations, and above ground using approved paint in accordance with Section 02265 – Polyurethane Coatings on Steel and Ductile Iron Pipe.

END OF SECTION

**SECTION 02567
PUMP CONTROL SYSTEM FOR WASTEWATER LIFT STATION**

PART I: GENERAL

1.1 SCOPE OF WORK

- A. The work in this section shall include furnishing and placing into operation the monitoring and control panel a pump station with 2 submersible wastewater pumps.
- B. The controller shall alternate the pumps and operate the pumps always at its best efficiency.

1.2 RELATED SECTIONS

- A. Section 02566 SUBMERSIBLE WASTEWATER PUMPS

1.3 REFERENCES

- A. Electrical work shall be in accordance with Division 16 – Electrical
- B. UL 508A and 698A
- C. NFPA 70 - NEC (2017)
- D. NFPA 820
- E. ISA 5.1 and 5.4

1.4 SUBMITTALS

- A. Submittals shall include but not be limited to the following:
 - 1. Shop drawings
 - 2. Bill of Material (BOM)
 - 3. Wiring diagrams
 - 4. Outline and dimension drawings
 - 5. Enclosure mounting details

1.5 QUALIFICATION REQUIREMENTS

- A. The manufacturer shall provide data on alternate equipment manufacturer's experience. Only Manufacturers with 20 or more years of experience who have furnished at least 20 similar lift stations that have been in regular operation not less than 5 years will be considered. Evidence of experience and operational data may be required from the manufacturer to determine the suitability and efficiency of the equipment offered.
- B. The Manufacturer shall be able to offer Alarm Transmission Service via CLOUD (Internet) for a monthly fee. Information such as SMS or email shall be available 24 hours / 7 days with and update interval: 60 seconds.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of

Section 01070 Temporary Facilities and Control

- B. Store in a clean, dry space.
- C. Lift only with lugs provided for the purpose.
- D. Handle carefully to avoid damage to internal components, enclosure and finish.

1.7 INSTALLATION

- A. After installation, a pump station start-up shall be performed by the installation contractor under the supervision of the manufacture's authorized representative 10 days of field service shall be provided by an authorized, factory trained representative of the pump manufacturer. Services shall include, but not be limited to, inspection of the completed pump station installation to ensure that it has been performed in accordance with the manufacturer's instructions and recommendations, supervision of all field-testing and activation of the Pump Manufacturer's Warranty. The test shall demonstrate to the satisfaction of the Owner that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly without exceeding the full load amperage rating of the motor. The Contractor shall be responsible for coordinating the required field services with the Pump Manufacturer.
- B. All electrical work performed shall be in full accordance to the requirements of the Division 16 (Electrical) Specifications.

1.8 WARRANTY

- A. When installed in accordance with all the provisions of this section, related sections and the supplier's installation manual, the warranty on the Monitoring and Control equipment shall be 12 months.
- B. The warranty period shall start from the date of equipment delivery to the job site.

PART II: PRODUCTS / MONITORING & CONTROL

2.1 MONITORING & CONTROL / PUMP DRIVE (FLYGT SMARTRUN SRC 300 OR EQUIVALENT)

- A. The station is equipped with 2 pumps. Each pump shall be equipped with a pump drive unit sized to match the submersible electric motor and designed for a power supply from 230-480V 60 Hz 3 phase.
- B. The pump drive shall provide all level control functionality, hand/auto operation, pump alternation, pump over temperature monitoring, seal leakage monitoring, pump self-cleaning, and pipe cleaning algorithms. The pump drive shall also include capability to monitor station inflow, pump speed and energy consumption in order to automatically operate the pump station at optimal energy efficiency.
- C. One Pump drive per pump should be used to allow full redundancy and alternation.

- D. It shall be tested and approved in accordance with international standards, the European safety directive 98/37/EC, the Low Voltage Directive 2006/95/EC, the EMC Directive 2004/108/EC and in accordance with the European standards: EN 61800-5-1:2003; EN 61800-3; EN 55011:2007; EN60529 and EN 60204-1.
- E. The software shall be programmed with all parameters and settings pre-configured for an efficient operation.
- F. It shall be freestanding for wall mounting or cabinet installation construction and equipped with an air ventilated system.
- G. Without any limitation or derating, it shall operate in ambient temperature of up to 40°C (104°F) at an altitude up to 1000m.
- H. It shall include provision for external communication to higher-level system. Communication shall be via 2-wire RS-485 connection to the pump drive. Communication shall be available as MODBUS RTU.
- I. Serial communication capabilities shall include, but not be limited to set Start- and stop level, Pump clean interval, speed and ramp times as well as PID control parameters.
- J. The communication telegram shall include process variable feedback like Sump level, power (kW), Output speed/frequency, current (A), % torque, relay outputs, digital inputs and drive status and fault information.
- K. Following function shall be provided by the equipment:
 - 1. High/Low Level Sump Control:
 - a. The pump drive shall provide automatic level control via means of a submersible pressure transducer (4-20mA DC). User-programmable Start Level shall indicate the point at which the pump will start. Upon activation the pump shall run at maximum speed for a pre-determined period, then ramp down to the energy efficient Optimal speed, calculated by the pump drive. When the water level reaches the Stop Level, the pump shall stop. The Optimal Speed shall either be calculated by the pump drive or manually entered by the user.
 - b. In case of high inflow, the pump drive shall increase pump speed until the water level begins to decrease. When the water level reaches the Stop Level, the pump shall stop.
 - c. In case of very high inflow, in a duplex installation, when a single pump is unable to overcome the inflow conditions even at maximum speed, additional pumps shall be activated and run at maximum speed until the Stop Level is reached. If water levels continue to rise, a High Level Alarm shall be activated.
 - d. The pump drive shall incorporate a Minimum Speed function that prevents the pump from operating at

- speeds too low to move water based on the pump curve.
2. Run Time Averaging and random start levels
 - a. The pump drive shall provide capability to balance run times for even wear. This shall be an internal function of the drive and not require external devices, such as an alternating relay.
 - b. Each drive shall determine its own random start level independent of each other. New random start levels shall be determined after each pump cycle. The pump with the lowest random start level shall be first to start on any given pump cycle. The second pump shall remain in Standby capacity in case the lead pump shall not be able to lower the water level as described in the section above. By recalculating the random start levels every pump cycle the operating hours of the pumps shall be balanced and the settling of "Grease-rings" in the station shall be avoided.
 3. Pump Cleaning Function:
 - a. The Pump drive shall incorporate a "self-cleaning" function to remove debris from the impeller. The cleaning shall be triggered by following circumstances:
 - Soft Clogging: When motor current is increasing over a certain period of time defined by the pump supplier.
 - Hard Clogging: When motor current is increase drastically and pump stops.
 - b. The cleaning function shall consist of forced stopping, reversal and forward runs timed to allow for debris to fall from the impeller. After cleaning cycle is complete, drive shall resume to automatic operation.
 4. Sump Cleaning Function:
 - a. The pump drive shall incorporate a sump cleaning function to ensure surface solids and grease is regularly removed from the sump. The sump cleaning function shall perform regularly when enabled by the

operator. Sump cleaning shall consist of the following functions:

- Sump cleaning is triggered when internal timer expires and during a normal pump down cycle.
- Pump is automatically ramped to maximum speed.
- Pump runs at maximum speed for designated time or until the pump are snoring.
- When Sump Cleaning is over, the pump is shut off and resumes normal operation.

5. Pipe Cleaning Function:

- a. The pump drive shall incorporate a pipe cleaning function to avoid discharge pipe sedimentation and clogging due to reduced pump speed. This shall be an automatic feature that initiates with every pump cycle. Upon reaching Pump Start Level, the drive shall operate the pump at 100% speed for a determined time before ramping down to the most energy efficient speed for the duration of the cycle.

6. Energy efficient speed finder:

- a. The pump drive shall provide a function that automatically calculates the most energy efficient speed for the pump based on station inflow characteristics. The speed shall be constantly adjusted to account for changes of the inflow without requiring operator adjustment.
- b. This function shall also prevent the drive from running off of the system curve and ensure the maximum hydraulic efficiency.

7. Alarms & Monitoring:

- a. The pump drive shall provide alarms and monitoring for the drive, pump and sump. Alarms shall be presented on the LCD display, via a Summary Alarm

relay and via Modbus registers. All alarms, when occurring, shall remain active until reset.

Alarms shall have a built-in 4 second delay to prevent nuisance tripping.

Alarms shall be as follows:

1. Motor monitoring:
 - a. Motor Temperature too high
 - b. Leakage in stator housing
2. Sump monitoring:
 - a. High sump Level (via float switch or transducer)
 - b. Transducer sensor error (connection failure, faulty values)
3. Pump drive monitoring:
 - a. Overcurrent or overload trip
 - b. Over- or under voltage
 - c. Ambient or drive temperature too high
 - d. Ambient temperature too low.
 - e. Input phase loss
 - f. Max torque exceeded

L. USER INTERFACE

1. The pump drive shall incorporate an (OLED) LCD screen to display drive operating status, alarms, liquid level and parameters.
2. The pump drive shall include 7 pushbuttons with the following functions: Pump Start, Pump Stop, Hand (Manual) Operation, Auto Operation, Menu Access, Increase Value, and Decrease Value.
3. Pump Start Level, Operating Parameter Adjustment and Alarm History shall be accessed via menu structure. Menu shall have at least 2 levels of security, limiting access to qualified personnel only.
4. The LCD screen shall display status information in 4 modes: Off, standby, active auto and active Manual.
5. The information shown shall be as follows:
 - a. OFF: Firmware name, Status ("STOP"), Rating (kW/hp)
 - b. STANDBY: Status and Name, Operating Mode, Sump Level
 - c. Auto/Manual: Status and Name, Operating Mode, Motor Freq. Power, Sump Level, Current

2.2 LEVEL CONTROL (FLYGT ENM 10)

- A. Each station shall be equipped with 2 Float switches for backup level sump control approved according LVD EN61058.
 - B. CSA approved according Class I Zone 0, Gr. IIC and Div.1 Gr A, B, C&D
 - C. Material of casing: Polypropylene.
 - D. Degree of protection: NEMA 6.
 - E. They shall be applicable for liquids with a density of 0.95 – 1.10 g/cm³.
The Level control shall include 40 feet submersible cable.
- 2.3 LEVEL TRANSMITTER (FLYGT LTU 801)
- A. Each station shall be equipped 1 Level transmitter approved acc. EN 61000-6-2, EN 61000-6-3, EN 61326-1. It shall be approved for explosive areas according UL Class 1, 2 and 3 Division 1 Group A-D T4/T5/T6
 - B. Output 4–20 mA direct current, proportional to the measured level. Low supply voltage 8–30 V DC – or battery operation.
 - C. It shall be suitable for waste water with a diaphragm made of ceramic.
 - D. Insulated > 100 MΩ at 500 V DC. Material of sensor body: Ryton PPS.
 - E. Degree of protection: Nema 6.
 - F. The transmitter shall include 35 feet submersible cable.
- 2.4 CABINET
- A. The Monitoring & Control and the telemetry and 2 pump drives shall be assembled in a cabinet. It shall be made of Reinforced plastic or stainless steel and it shall be prepared for an installation on a concrete floor.
 - B. Beside the Monitoring & Control unit it shall have enough space for the customer-installed telemetry equipment and include.
 - 1. 1 backup battery for the telemetry unit.
 - 2. Red-dome style flashing alarm light
 - 3. Alarm Horn or Bell with Alarm silence button
 - 4. Intrinsically safe barrier for UL 913 requirements
 - 5. Anti-condensation heater and thermostat
 - 6. Generator receptacle and Emergency circuit breaker (walking-beam interlocked with Main breaker)
 - 7. Enclosure legs
 - 8. Power switch, which can be locked in the off position by a pad-lock.
 - 9. 1 light group with socket
 - C. The inner dimension of the cabinet shall reserve at least 10% back panel space for future adjustments.
 - D. All components on the front of the machine should be provided with function plate.

PART III: EXECUTION

3.1 GENERAL

- A. Perform installation in accordance with Contract Documents and manufacturers specifications.

3.2 EXAMINATION

- A. A factory trained technician shall examine the work area prior to beginning work and check the following:
 - 1. The environment is safe to begin working in
 - 2. All surfaces are ready to receive work
 - 3. All tools are in the proper location and are in good condition
 - 4. Grounding of the system

3.3 FIELD QUALITY CONTROL

- A. The following field tests shall be performed by a factory trained technician
 - 1. Point to point wiring verification
 - 2. Utility power verification
 - 3. Site acceptance testing
 - 4. System demonstration
- B. Point to Point I/O Verification
 - 1. After installation of the pumps and the control panel, a factory trained technician shall prepare the I/O checklist. The checklist shall include the following:
 - a. All inputs and outputs connected to the control panel
 - b. All alarms that can be generated by the control panel
 - 2. The technician shall follow a test procedure to test all I/O and alarms.
 - a. All digital inputs shall be tested from point of origin unless it is unsafe.
 - b. All digital outputs shall be tested by running a simulation test from the controller or by simulating the fault condition.
 - c. All analog inputs shall be tested from the point of origin where possible and by use of a signal generator otherwise.
 - d. All analog outputs shall be tested by running a simulation program or by forcing the output to a value.
 - 3. The technician shall follow a test procedure to ensure the system operation parameters are met.
- C. Configuration Verification
 - 1. The factory trained technician shall document the settings using a factory provided configuration checklist. Each

parameter shall be verified prior to the beginning of testing and then again after testing is completed.

2. The configuration of the pump station manager as well as the IPS gateways shall be documented.
3. The pump station manager configuration shall be saved to a factory provided SD card after testing is completed.

3.4 FACTORY TRAINED SUPERVISION

- A. The contractor shall procure a factory trained technician to check over equipment prior to putting the equipment into operation.
- B. Point to point test of all wiring.
- C. Functional test of all equipment alarms and controls.

3.5 CERTIFICATION OF TESTING

- A. All tests shall be performed in the presence of a duly authorized representative of the Owner. If the presence is waived, certified results shall be provided by the Contractor.
- B. Written notice of all tests shall be given two weeks in advance.

3.6 TEST EQUIPMENT

- A. All test equipment shall be provided by the Contractor.

3.7 TRAINING

- A. Training shall be a minimum of four (4) hours and cover the complete Pumping System and related controls.
- B. Instruction material shall be provided for four (4) trainees.

3.8 ANNUAL PREVENTATIVE MAINTENANCE AGREEMENT

- A. Training In addition to the pump(s) the supplier shall provide a minimum one-year preventative maintenance agreement that includes a minimum of one annual site visit with a multi-point pump(s) inspection performed by manufacturer certified and manufacturer trained technician(s) within 12 months of installation.
- B. The multi-point inspection shall include visual and functional inspections of all wet well components, pumps and control panels; oil inspection and oil change of submersible pumps; pertinent physical and electrical data to reasonably expect prolonged equipment operation for a year of additional service.
- C. The end-user shall also be provided a copy of a summarized report at the conclusion of the multi-point inspection.

END OF SECTION

SECTION 02568

EPOXY LINERS FOR SANITARY SEWER STRUCTURES

PART I: GENERAL

1.01 SUMMARY

- A Section Includes:
 - 1. Application of an epoxy coating system to new concrete utility structures such as manholes, lift station wet wells, junction boxes, or other concrete facilities that may need protection from corrosive materials.
- B References Technical Specifications:
 - 1. Section 01100 – Summary of Work
 - 2. Section 01000 – Submittals
 - 3. Section 02535 – Sanitary Sewer Lift Station
 - 4. Section 03015 – Structural Concrete

1.02 MEASUREMENT AND PAYMENT

- A Unless indicated as a Bid Item, no separate payment will be made for epoxy liners under this Section. Include cost in Bid Items for installed Work.

1.03 SUBMITTALS

- A Make Submittals required by this and related Sections under the provisions of Section 01000 – Submittals.
- B All Submittals shall be approved by the Owner prior to delivery.

1.04 REFERENCES

- A Reference Standards:
 - 1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
 - 2. ASTM International (ASTM):
 - C109, Compressive Strength Hydraulic Cement Mortars
 - C579, Compressive Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars
 - D543, Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
 - D638, Standard Test Method for Tensile Properties of Plastics

- D695, Standard Test Method for Compressive Properties of Rigid Plastics
- D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
- D4258, Standard Practice for Surface Cleaning Concrete
- D4259, Standard Practice for Abrading Concrete
- D4414, Standard Practice for Measurement of Wet Film Thickness by Notch Gages
- D4541, Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers
- ASTM D4787, Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
- 3. Environmental Protection Agency (EPA)
- 4. NACE International (NACE)
 - a. NACE RPO 188-99
- 5. Occupational Safety and Health Administration (OSHA)
- 6. Resource Conservation and Recovery Act, (RCRA)
- 7. The Society for Protective Coatings/NACE International (SSPC/NACE):
 - a. SP 13/NACE No. 6, Surface Preparation of Concrete PA 9
- 8. International Concrete Repair Institute (ICRI)
 - a. ICRI Guideline No. 03732

1.05 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

- A Product Data:
 - 1. Technical data sheet on each product used
 - 2. Material Safety Data Sheet (MSDS) for each product used
 - 3. Copies of independent testing performed on the coating product indicating the product meets the requirements as specified herein
 - 4. Technical data sheet and project specific data for repair materials to be topcoated with the coating product including application, cure time and surface preparation procedures
- B Contractor Data:
 - 1. Current documentation from coating product manufacturer certifying Contractor's training and equipment complies with the Quality Assurance requirements specified herein
 - 2. 5 recent references of Contractor indicating successful application of coating product(s) of the same material type as specified herein, applied by spray application within the municipal wastewater environment

1.06 QUALITY ASSURANCE

- A Qualifications:
 - 1. Contractor
 - a. Be trained by, or have training approved and certified by, the coating product manufacturer for the handling, mixing, application and inspection of the coating product(s) to be used as specified herein
 - 2. The Contractor must have a minimum of 50,000 square feet of successful wastewater system installation and three years of rehabilitation experience.
- B Product:
 - 1. For a product to be commercially acceptable, the product must have a minimum 500,000 square feet and five (5) year history of successful wastewater collection system installation in the United States.

1.07 DELIVERY, STORAGE, AND HANDLING

- A Keep materials dry, protected from weather and stored under cover.
- B Store coating materials between 50 degrees F and 90 degrees F.
Do not store near flame, heat or strong oxidants.
Handle coating materials according to their material safety data sheets.

1.08 FIELD [SITE] CONDITIONS

- A Provide confined space entry, flow diversion and/or bypass plans as necessary to perform the specified work.

1.09 WARRANTY

- A Contractor Warranty:
Contractor's Warranty shall be in accordance with Division 0.

PART II: PRODUCTS

2.1 EQUIPMENT, PRODUCT TYPES, MATERIALS

- A Repair and Resurfacing Products:
 - 1. Compatible with the specified coating product(s) in order to bond effectively, thus forming a composite system
 - 2. Used and applied in accordance with the manufacturer's recommendations
 - 3. The repair and resurfacing products must meet the following:
 - a. 100 percent solids, solvent-free epoxy grout specifically formulated for epoxy topcoating compatibility
 - b. Factory blended, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar that can be troweled or pneumatically spray applied and specifically formulated to be suitable for topcoating with the specified coating product used

- B Coating Product:
1. Capable of being installed and curing properly within a manhole or concrete utility environment
 2. Resistant to all forms of chemical or bacteriological attack found in municipal sanitary sewer systems; and, capable of adhering to typical manhole structure substrates
 3. The 100 percent solids, solvent-free ultra high-build epoxy system shall exhibit the following characteristics:
 - Application Temperature – 50 degrees F, minimum
 - Thickness – 125 mils minimum
 - Color – White, Light Blue, Pink or Beige
 - Compressive Strength (per ASTM D695) – 8,800 psi minimum
 - Tensile Strength (per ASTM D638) – 7,500 psi minimum
 - Hardness, Shore D (per ASTM D4541) – 70 minimum
 - Abrasion Resistance (per ASTM D4060 CS 17F Wheel) – 80 mg loss maximum
 - Flexural Modulus (per ASTM D790) – 400,000 psi minimum
 - Flexural Strength (per ASTM D790) – 12,000 psi minimum
 - Adhesion to Concrete, mode of failure (ASTM D4541): Substrate (concrete) failure
 - Chemical Resistance (ASTM D543/G20) all types of service for:
 - Municipal sanitary sewer environment
 - Sulfuric acid, 30 percent
 - Sodium hydroxide, 5 percent
 4. Coating must be designed for temperatures up to 200 degrees F.
 5. Approved products include Raven 405. Other products may be submitted for review and approval.
- C Coating Application Equipment:
1. Manufacturer approved heated plural component spray equipment
 2. Hard to reach areas, primer application and touch-up may be performed using hand tools.

2.2 SOURCE QUALITY CONTROL

- A Testing:
1. Take wet film thickness gauge per ASTM D4414 at 3 locations within the manhole, 2 spaced equally apart along the wall and 1 on the bench. Document and attest measurements and provide to the Owner.
 2. After coating has set perform a spark test to identify holidays. Repair all pinholes by lightly abrading the surface and brushing the lining material over the area.
 3. Perform a pull test.
 4. Repair all blisters and evidence of uneven cover according to the manufacturer's recommendations.

PART III: EXECUTION

3.1 INSTALLERS

- A All installers shall be certified applicators approved by the manufacturers. Contractor shall have a manufacturer's representative present at the start of the coating procedure.

3.2 PREPARATION

- A Manhole / Lift Station Preparation:
 - 1. Stop active flows via damming, plugging or diverting as required to ensure all liquids are maintained below or away from the surfaces to be coated.
 - 2. Maintain temperature of the surface to be coated between 40 and 120 degrees F.
 - 3. Shield specified surfaces to avoid exposure of direct sunlight or other intense heat source.
 - 4. Where varying surface temperatures do exist, coating installation should be scheduled when the temperature is falling versus rising.
 - 5. Remove all steps, protrusions or other such obstructions prior to beginning the lining process as directed by the Owner.
 - 6. Prior to commencing surface preparation, Contractor shall inspect all surfaces specified to receive the coating and notify Owner, 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.
 - 7. **New Portland cement (not quick setting, high strength) concrete manhole or structures shall have cured a minimum of 28 days since manufacture prior to commencing coating installation.**
- B Surface Preparation:
 - 1. Offset structural components, lids, covers, frames, etc. shall be repaired, replaced, or reset prior to the commencement of surface preparation.
 - 2. Remove oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts or other contaminants which may affect the performance and adhesion of the coating to the substrate.
 - 3. Remove concrete and/or mortar damaged by corrosion, chemical attack or other means of degradation so that only sound substrate remains.
 - 4. Surface preparation method, or combination of methods, that may be used include high pressure water cleaning, high pressure water jetting, abrasive blasting, shotblasting, grinding, scarifying, detergent water cleaning, hot water blasting and others as described in SSPC SP 13/NACE No. 6. and ICRI Technical Guideline No. 03732.

5. All methods used shall be performed in a manner that provides a uniform, sound, clean, neutralized, surface suitable for the specified coating product. Resulting concrete surface profile (CSP) shall be at least a CSP-4 in accordance with ICRI Technical Guideline No. 03732 as referenced in section 1.03. Typically, CSP ranges from CSP 1 (nearly flat) through CSP 9 (very rough) as indicated through ICRI Guideline No. 03732.

3.3 INSTALLATION

A General:

1. Perform coating after the sewer line replacement/repairs, grade adjustments and grouting are complete.
2. Perform application procedures per recommendations of the coating product manufacturer, including environmental controls, product handling, mixing and application.
3. Initiate and enforce quality control procedures consistent with the coating product(s) manufacturer recommendations and applicable NACE or SSPC standards as referenced herein.

B Temperature:

1. Only perform application if surface temperature is between 40 and 120 degrees F.
2. Make no application if freezing is expected to occur inside the manhole within 24 hours after application.

C Repair/Resurfacing:

Repair/resurfacing products as per section 2.02.A shall be used to fill voids, bugholes, and other surface defects which may affect the performance or adhesion of the coating product(s).

D Coating:

1. Spray apply per manufacturer's recommendation at a minimum dry film thickness of 125 mils with a minimum surface profile of CSP-4 in accordance with ICRI Technical Guideline No. 03732
2. Apply coating from bottom of manhole frame to the bench/trough, including the bench/trough.
3. After walls are coated, remove bench covers and spray bench/trough to at least the same thickness as the walls.
4. Apply any topcoat or additional coats within the product's recoat window.
5. Additional surface preparation is required if the recoat window is exceeded.
6. Allow a minimum of 3 hours of cure time or be set hard to touch before reactivating flow.

3.4 FIELD [OR] SITE QUALITY CONTROL

- #### A 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 Owner.
 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.
- B After the coating product(s) have cured in accordance with manufacturer recommendations, all surfaces shall be inspected for holidays as per 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 materials(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 Owner/Engineer by Contractor.
- C Adhesion of the coating system to the substrate shall be confirmed in a minimum of 10% of the manholes coated. 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. Owner's representative shall select the manholes or areas to be tested.
- D Each structure will be visually inspected the same day following the application.
- E The inspector will check for deficiencies, pinholes and thin spots.
- F If leaks are detected they will be chipped back, plugged and coated immediately with protective epoxy resin coating.
- Make repair 24 hours after leak detection.

3.5 CLOSEOUT ACTIVITIES

- A Upon final completion of the work, the manufacturer will provide a written certification of proper application to the Owner.
- B The certification will confirm that the deficient areas were repaired in

accordance with the procedure set forth in this Specification.

END OF SECTION

SECTION 02905 TOPSOIL

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Furnishing and placing topsoil for finish grading and for seeding, sodding and planting.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment shall be made for topsoil under this Section. Include payment in Section 02910 – Hydromulch Seeding or Section 02915 – Sodding.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCENCES

- A. CFTS – City of Friendswood Technical Specifications.

PART II: PRODUCTS

2.1 TOPSOIL

- A. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having characteristics specified in TABLE 4.1 – TOPSOIL CHARACTERISTICS in this Section.
- B. Topsoil shall be reasonably free of subsoil, clay lumps, weeds, non-soil materials and other litter or contamination. Topsoil shall not contain roots, stumps and stones larger than two inches (2 In).
- C. Obtain topsoil from naturally well-drained areas where topsoil occurs at a minimum depth of four inches (4 In) and has similar characteristics to that found at placement site. Do not obtain topsoil from areas infected with growth of or reproductive parts of nut grass or other noxious weeds.

PART III: EXECUTION

3.1 EXAMINATION

- A. Excavate topsoil for esplanades and areas to receive grass or landscaping from areas to be further excavated. Stockpile in area approved by the Project Manager.
- B. Stockpile topsoil to depth not exceeding eight feet (8 Ft). Cover to protect

from erosion.

3.2 TOPSOIL EXCAVATION

- A. Conform to excavation and stockpiling requirements of Section 02135 – Excavation for Roadway.

3.3 PLACEMENT

- A. Place no topsoil until subgrade has been approved. For areas to be seeded or sodded, scarify or plow existing material to a minimum depth of four inches (4 In) or as indicated on the Drawings. Remove vegetation and foreign inorganic material. Place four inches (4 In) of topsoil on loosened material and roll lightly with appropriate lawn roller to consolidate topsoil.
- B. Increase depth of topsoil to six inches (6 In) when placed over sand bedding and backfill materials specified in Section 02140 – Utility Backfill Materials.
- C. For areas to receive shrubs or trees, excavate existing material and place topsoil to depth and dimensions shown on the Drawings.
- D. Remove spilled topsoil from curbs, gutters and, paved areas and dispose of excess topsoil in accordance with requirements of Section 01580 – Waste Material Disposal.
- E. Place topsoil to promote good drainage and compact with light roller. Water topsoil after placement until saturated for a minimum depth six inches (6 In), fill in and recompact areas of settlement.

3.4 PROTECTION

- A. Protect topsoil from wind and water erosion until planting is completed.

PART IV: TABLES

4.1 TOPSOIL CHARACTERISTICS

TOPSOIL CHARACTERICISTICS	
CHARACTERISTIC	VALUE
pH Value	Between 5.5 and 6.5
Liquid Limit	50 or Less
Plasticity Index	20 or Less
Gradation	Maximum of 10% passing No. 200 Sieve

END OF SECTION

SECTION 02910 HYDROMULCH SEEDING

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Seeding, fertilizing, mulching and maintenance of areas indicated on the Drawings.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for Hydromulch seeding is on an acre basis.
 - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit certification from supplier that each type of seed conforms to these Specifications and requirements of Texas Seed Law. Certification shall accompany seed delivery.
- C. Submit certificate stating that fertilizer complies with these Specifications and requirements of Texas Fertilizer Law.

1.4 REFERENCES

- A. CFTS – City of Friendswood Technical Specifications.
- B. Texas Seed Law.
- C. USDA – United States Department of Agriculture rules and regulations of Federal Seed Act.

PART II: PRODUCTS

2.1 MATERIALS

- A. Topsoil: Conform to material requirements of Section 02905 – Topsoil.
- B. Seed: Conform to U.S. Department of Agriculture rules and regulations of Federal Seed Act and Texas Seed Law. Seed shall be certified ninety percent (90%) pure and furnish ninety percent (90%) germination and meet following requirements:
 - 1. Rye: Fresh, clean, Italian rye grass seed (*Lolium multi-florum*), mixed in labeled proportions. As tested, the minimum percentages of impurities and germination must be labeled. Deliver in original unopened containers.
 - 2. Bermuda: Extra-fancy, treated, lawn type common Bermuda

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- (Cynodon dactylon). Deliver in original, unopened container showing weight, analysis, name of vendor and germination test results.
3. Wet, moldy or otherwise damaged seed shall not be accepted.
 4. Seed requirements, application rates and planting dates are as specified in TABLE 4.1 – SEEDING CONDITIONS in this Section.
- C. Fertilizer: Dry and free flowing, inorganic, water soluble commercial fertilizer, which is uniform in composition. Deliver in unopened containers which bear manufacturers guaranteed analysis. Caked, damaged or otherwise unsuitable fertilizer shall not be accepted. Fertilizer shall contain the minimum percentages of elements as specified in TABLE 4.2 – MINIMAL FERTILIZER ELEMENTS in this Section.
- D. Mulch:
1. Virgin wood cellulose fibers from whole wood chips having a minimum of twenty percent (20%) fibers forty-two hundredths inches (0.42 In) in length and one hundredth inch (0.01 In) in diameter.
 2. Cellulose fibers manufactured from recycled newspaper and meeting same fiber content and size as for cellulose fibers from wood chips.
 3. Dye mulch green for coverage verification purposes.
- E. Soil Stabilizer: "Terra Tack 1" or approved equal.
- F. Weed control agent: Pre-emergent herbicide for grass areas, such as "Benefin," or approved equal.

PART III: EXECUTION

3.1 PREPARATION

- A. Place and compact topsoil in accordance with requirements of Section 02905 – Topsoil.
- B. Dispose of Objectionable and Waste Materials in accordance with Section 01580 – Waste Material Disposal.

3.2 APPLICATION

- A. Seed: Apply uniformly at rates given in TABLE 4.1 – SEEDING CONDITIONS in this Section, for type of seed and planting date.
- B. Fertilizer: Apply uniformly at rate of five hundred pounds (500 Lbs) per acre.
- C. Mulch: Apply uniformly at rate of fifty pounds (50 Lbs) per one thousand square feet (1000 Sf).
- D. Soil Stabilizer: Apply uniformly at rate of forty pounds (40 Lbs) per acre.
- E. Weed Control Agent: Apply at manufacturer's recommended rate prior to hydro mulching.
- F. Sod: Lay single row of sod along perimeter where top soil and pavement

intersect. Apply in conformance to Section 02915 – Sodding.

- G. Suspend operations under conditions of drought, excessive moisture, high winds or extreme or prolonged cold. Obtain the Project Manager's approval before resuming operations.

3.3 MAINTENANCE

- A. Maintain grassed areas for a minimum of ninety days (90 D) or as required to establish an acceptable lawn. For areas seeded in fall, continue maintenance following spring until acceptable lawn is established.
- B. Maintain grassed areas by watering, fertilizing, weeding and trimming.
- C. Repair areas damaged by erosion by re-grading, rolling and replanting.
- D. Reseed small, sparse grass areas. When sparse areas exceed ten percent (10%) of planted area, reseed by hydro mulch.
- E. Mow grass when height reaches three and one-half inches (3-1/2 In) or greater on average before final acceptance. Mow to height of two and one-half inches (2-1/2 In).

PART IV: TABLES

4.1 SEEDING CONDITIONS

GRASS SEEDING CONDITIONS		
TYPE	APPLICATION RATE lbs/ac	PLANTING DATE
Hulled Common Bermuda 88/98	40	Jan 1 to Mar 31
Unhulled Common Bermuda 88/98	40	
Hulled Common Bermuda 88/98	40	Apr 1 to Sep 30
Hulled Common Bermuda 88/98	40	Oct 1 to Dec 31
Unhulled Common Bermuda 88/98	40	
Annual Rye Grass (Gulf)	30	

4.2 MINIMAL FERTILIZER ELEMENTS

MINIMAL FERTILIZER ELEMENT PERCENTAGES	
ELEMENT	PERCENTAGE
Nitrogen	10%
Phosphoric Acid	20%
Potash	10%

END OF SECTION

02910-3

SECTION 02935 CHAIN LINK FENCE

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Furnishing and installation of chain link fencing, galvanized steel posts, and gates plus all accessories incidentals and specials necessary for the proper erection and installation of the fence and gates.
- B. The Contractor shall construct chain link fencing including posts, and gates as shown on the Drawings and in accordance with this Specification.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for Chain Link Fence shall be on a per linear foot basis to include all necessary hardware, concrete, materials and labor.
 - 2. No separate payment shall be made for each gate. Gates shall be paid under Chain Link Fence as part of the linear footage.
 - 3. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

- A. ASTM – American Society for Testing and Materials.
 - 1. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A90 – Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - 3. ASTM A121 – Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
 - 4. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 5. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
 - 6. ASTM A392 – Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
- B. CTFS – City of Friendswood Specifications.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit proposed design mix and test data for each type and strength of concrete.

- C. Submit manufacturer's data and details of following items for approval:
 - 1. Chain Link Fabric Mesh.
 - 2. Galvanized Posts.
 - 3. Materials to be used for installation.
 - 4. Latch and hinge hardware.
 - 5. Installation instructions for forms.

PART II: PRODUCTS

2.1 FABRIC

- A. Wire Fabric for fencing shall be nine gauge (9 Ga) steel with a minimum tensile strength of eighty thousand pounds per square inch (80,000 psi). Mesh size shall be two inches (2 In) between parallel wires. Top salvages knuckled for sixty inch (60 In) or less in height. Top and bottom salvages twisted and barbed for fabric over sixty inches (60 In) in height. Fabric shall be furnished in one-piece.
- B. Barbed Wire for mounting on security arms to be twelve and one-half gauge (12 1/2 Ga) with four-point (4 pt) barbs spaced at five inches (5 In) apart. Three (3) strands of barbed wire shall be required.
- C. Fabric Ties shall be eleven gauge (11 Ga) steel to fasten fabric to top rail at eighteen inch (18 In) intervals. Ties shall be furnished to fasten the fabric to the bottom tension wire at eighteen inch (18 In) intervals. Ties shall be furnished to attach fabric to line posts at fifteen inch (15 In) intervals.
- D. Bottom Tension Wire shall be seven gauge (7 Ga) coil wire.

2.2 RAILS AND POSTS

- A. Top Rail shall be one and sixty-six hundredths inch (1.66 In) outside diameter (OD) steel pipe weighing two and twenty-seven hundredths pounds per foot (2.27 lb/ft). Top rail shall be furnished in random lengths not less than eighteen feet (18 Ft) per section and shall be joined with outside sleeve, steel couplings not less than six inches (6 In) long and having a wall thickness not less than seven hundredths of an inch (0.7 In) Couplings shall be designed to allow for expansion and movement of the top rail.
- B. Posts shall be furnished in sufficient quantity to provide a maximum spacing of ten feet (10 Ft). Minimum size and weights are as specified in TABLE 4.1 – LINER POST REQUIREMENTS, TABLE 4.2 – CORNER, PULL AND END POST REQUIREMENTS, and TABLE 4.3 – GATE POSTS in this Section.
- C. Post Brace Assembly shall be manufacturers standard adjustable brace at end and gate posts, at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Brace to be same material as top rail and trussed to line posts with three-eighths inch (3/8 In) diameter rod with adjustable turnbuckles.
- D. Post Caps for pipe shall be designed to exclude moisture. Where barbed

02935-2

wire is specified, extension arms shall be integral with post caps. Where top rail is specified, post caps shall have an opening for the top rail. All post caps shall have a two inch (2 In) skirt for rigidity.

- E. Tension bars shall be not less than three-sixteenths of an inch (3/16 In) by three-quarters of an inch (3/4 In) flat steel and not more than two inches (2 In) shorter than the fabric height. One (1) tension bar shall be provided for each gate and end post. Two (2) tension bars shall be provided for each corner and pull post. Tension bars shall be attached to terminal posts with one inch (1 In) twelve gauge (12 Ga) flat steel bands, with carriage bolts at intervals not exceeding fifteen inches (15 In).
- F. Barbed Wire Support Arms shall be metal and finish to match fence framework, with provision for anchoring to posts and attaching three (3) rows of barbed wire with each arm. Supporting arms may either be attached to posts or integral with post top weather cap and shall be capable of withstanding two hundred fifty pounds (250 Lb) downward pull at outermost end. Arms shall be at a forty-five degree (45°) angle from vertical.

2.3 GATES

- A. Fabricate perimeter frames of gates from metal and finish to match fence framework. Assemble gate frames by welding or with special fittings and rivets for rigid connections, providing security against removal or breakage connections. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. Space frame members a maximum of eight feet (8 Ft) apart unless otherwise indicated. Provide same fabric as for fence, unless otherwise indicated. Install fabric with tension bars at vertical edges and at top and bottom edges. Attach tension bars to gate frame not more than fifteen inches (15 In) on center (OC).
 - 1. Install one (1) diagonal cross-bracing consisting of a minimum three-eighths inch (3/8 In) adjustable length truss rods with turn-buckles on gates to ensure frame rigidity without sag or twist.
 - 2. Where barbed wire is indicated above gates extend end members of gate frames one foot (1 Ft) above top member and prepare to receive three (3) strands of wire. Provide necessary clips for securing wire to extensions.
- B. Swing gates shall be fabricated with frames a minimum of one and seven-eighths inch (1 7/8 In) outside diameter (OD) pipe weighing two and seventy-two hundredths pounds per foot (2.72 Lb/Ft). The top of all gate frames shall align with the fencing top rail. Vehicular gates shall be four inches (4 In) greater in overall height than the adjacent fencing so as to extend to within two inches (2 In) of pavement between curb, if curbs are designated are designated on the Drawings.
 - 1. Corner and tee fittings of malleable iron or pressed steel having means of attaching diagonal members. Hinges of malleable iron

- providing for full one hundred eighty degree (180°) swing with bottom hinges to be ball and socket type.
- 2. Diagonal braces consisting of a minimum one-half inch (1/2 In) truss rods with turn-buckles, two (2) for each gate frame. Vertical gates shall have vertical one and seven-eighths inch (1 7/8 In) outside diameter (OD) pipe brace at the center of each gate leaf.
- C. Provide gate hardware and accessories for each gate galvanized in accordance with ASTM A153 and as specified below:
 - 1. Hinges: Size and material to suit gate size, non-liftoff type, offset to permit one hundred eighty degree (180°) gate opening. Provide three (3) hinges for each leaf over six foot (6 Ft) nominal height.
 - 2. Latch: Forked type or plunger-bar type to permit operation from either side of gate with padlock eye as integral part of latch.
 - 3. Provide keeper for vehicle gates which automatically engages gate leaf and holds it in open position until manually released. Keeper to be anchored at least twelve inches (12 In) into a twelve inch by twenty-four inch (12 In x 24 In) concrete footing.
 - 4. Double gates shall be provided with gate stops consisting of mushroom type flush plate with anchors, set in concrete, and designed to engage center drop rod or plunger bar. Include locking device and padlock eyes as integral part of latch permitting both gate leaves to be locked with single padlock.
- D. Roller Gates shall be the responsibility of the Contractor to design using same fabric as for fence. Drawings shall indicate the size of opening for single or double gate application. Design to provide for free flowing opening and closing. Additional rollers or support bearing wheel should be incorporated to minimize binding where necessary.

2.4 GALVANIZING

- A. All material used in chain link fencing shall be hot-dip zinc coated as specified by the following:
 - 1. All posts and pipe shall be one and eight-tenth ounces per square foot (1.8 Oz/SF) in accordance with ASTM A53.
 - 2. All H-Beam Sections shall be two ounces per square foot (2.0 Oz/SF) in accordance with ASTM A123.
 - 3. Fence Fabric shall be one and two-tenths ounces per square foot (1.2 Oz/SF) in accordance with ASTM A392, Class I.
 - 4. Tension and Barbed wire shall be eight-tenths ounce per square foot (0.8 Oz/SF) in accordance with ASTM A121, Class III.
 - 5. Post Caps, Tension Bars and Miscellaneous fittings shall be in accordance with ASTM A153.
 - 6. The weight of zinc coating for all items shall be determined in accordance with ASTM A90.

PART III: EXECUTION

3.1 INSTALLATION

- A. The fence shall be installed by skilled and experienced fence erectors, and on lines and grades indicated on the Drawings.

3.2 CONSTRUCTION

- A. The Contractor shall perform all clearing of brush and debris, which may be necessary for the installation of the fencing.
- B. The fencing panels between corner and terminal posts shall generally follow the finished ground elevations. The Contractor shall grade off minor irregularities in the path of the fencing as necessary to limit the variation of grade under bottom edge of fence fabric to a distance of not more than six inches (6 In) and not less than two inches (2 In) from the ground at any point along the fencing.
- C. Post Spacing:
 - 1. Line Posts shall have a maximum spacing of no more than ten feet (10 Ft).
 - 2. Pull Posts shall not be located more than five hundred feet (500 Ft) and shall be installed at each change in direction exceeding twenty degrees (20°), both vertically and horizontally.
 - 3. Runs of fencing over five hundred feet (500 Ft) but less than one thousand feet (1,000 Ft) shall have a pull post in the center of the run.
- D. Holes
 - 1. Holes for concrete footings for all posts shall be drilled to the dimension as specified in TABLE 4.4 – HOLES FOR LINE, TABLE 4.5 – HOLES FOR END POSTS, and TABLE 4.6 – HOLES FOR GATE POSTS.
 - 2. Concrete footings shall be Class A Concrete, NO EXCEPTIONS. Concrete shall be in accordance with Section 03300 – Structural Concrete. All concrete footings shall be cast up to finished grade and crowned one inch (1 In) to shed water. Excess concrete and other material shall be removed and disposed of in accordance with Section 01580 – Waste Material Disposal.
- E. The fence fabric shall be erected by securing one (1) end and applying sufficient tension to the other to remove all slack before making attachments. The fabric shall be cut and each span shall be attached independently at all corner posts and pull posts.
- F. Fastening to end, pull, corner and gate posts shall accomplished with tension bars which shall be secured to the post with tension bar bands at intervals not to exceed fifteen inches (15 In).
- G. Fence fabric shall generally follow the finished contour of the site with the bottom edge of the fabric located two inches (2 In) above the grade.
- H. Erect fencing to generally follow ground surface and adjust irregularities in grade. Where depressions or swales are crossed by the fencing,

provide galvanized pipe and wire fabric laced to main fabric to prevent entrance of small animals but permit natural drainage flow.

- I. Join top rails with suitable sleeve-type couplings, making rigid connections with provisions for expansion and contraction. Pass rail through base line post barbed wire extension arm and fasten securely to terminal post.
- J. Brace all terminal posts with brace member securely fastened to terminal and first line post. Tie terminal post near ground line to line post at brace member with steel tension rod complete with turn-buckle.

PART IV: TABLES

TABLE 4.1 LINE POST REQUIREMENTS

FABRIC HEIGHT (FT)	POST OUTSIDE DIA. (IN)	PIPE SECTION (LB/FT)	H-BEAM SECTION (LB/FT)	EMBEDMENT LENGTH (IN)
0 to 4	1.90	2.27	2.70	24
4 to 8	2.375	3.65	4.10	24
8 to 12	2.875	5.79	5.79	24

TABLE 4.2 CORNER POST, PULL POST AND END POST REQUIREMENTS

FABRIC HEIGHT (FT)	POST OUTSIDE DIA. (IN)	PIPE SECTION (LB/FT)	EMBEDMENT LENGTH (IN)
0 to 4	2.75	3.65	30
4 to 8	2.875	5.79	36
8 to 12	3.50	9.10	36

TABLE 4.3 GATE POST REQUIREMENTS

FABRIC HEIGHT (FT)	POST OUTSIDE DIA. (IN)	PIPE SECTION (LB/FT)	EMBEDMENT LENGTH (IN)
0 to 4	2.875	5.79	36
4 to 8	4.00	9.11	36
8 to 12	6.625	18.79	42

TABLE 4.4 HOLES FOR LINE POSTS

FABRIC HEIGHT (FT)	MINIMUM HOLE DIA. (IN)	MINIMUM HOLE DEPTH (IN)	POST EMBEDMENT (IN)
0 to 4	9	30	24
4 to 8	9	30	24
8 to 12	9	30	24

TABLE 4.5 HOLES FOR END POSTS

FABRIC HEIGHT (FT)	MINIMUM HOLE DIA. (IN)	MINIMUM HOLE DEPTH (IN)	POST EMBEDMENT (IN)
0 to 4	12	36	30
4 to 8	12	42	36
8 to 12	12	42	36

TABLE 4.6 HOLES FOR GATE POSTS

FABRIC HEIGHT (FT)	MINIMUM HOLE DIA. (IN)	MINIMUM HOLE DEPTH (IN)	POST EMBEDMENT (IN)
0 to 4	12	42	36
4 to 8	18	42	36
8 to 12	18	48	42

END OF SECTION

SECTION 03005 GROUT

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Mix design requirements, testing, furnishing and production of grout for:
 - 1. Pressure grouting of jacked-pipe.
 - 2. Annular grouting of cased or uncased sewer pipe.
 - 3. Grouting voids in ground resulting from caving, loss of ground or settlement.
- B. Compaction grouting is not part of this specification.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment shall be made for the Work performed under this Section. Include cost of such the Work in contract unit prices for the Work of which it is component part.
 - 2. Refer to Section 01270 - Measurement and Payment for Unit Price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for the Work in this Section is included in Total Stipulated Price.

1.3 DEFINITIONS

- A. Pressure Grouting: Filling void behind liner or pipe with grout under pressure sufficient to ensure void is properly filled but without overstressing temporary or permanent ground support or causing ground heave to occur.
- B. Annular Grouting: Filling annular space between carrier pipe and casing or ground, by pumping.
- C. Ground Stabilization Grouting: Filling of voids, fissures or under-slab settlement due to caving or loss of ground by injecting grout under gravity or pressure to fill void.

1.4 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials.
 - 1. ASTM C138 Standard Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete.
 - 2. ASTM C144 Standard Specification for Aggregate for Masonry Mortar.
 - 3. ASTM C150 Standard Specification for Portland Cement.
 - 4. ASTM C494 Standard Specification for Chemical Admixture for Concrete.
 - 5. ASTM C869 Standard Specification for Foaming Agents Used in Making Preformed Foam for Cellular Concrete.

6. ASTM C937 Standard Specification for Grout Fluidifier for Pre-placed Aggregate Concrete.
 7. ASTM C942 Standard Test Method for Compressive Strength of Grout for Pre-placed Aggregate Concrete into Laboratory.
 8. ASTM C1017 Standard Specification for Chemical Admixture for Use in Producing Flowing Concrete.
- B. CFTS – City of Friendswood Technical Specifications.

1.5 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures.
- B. Submit description of materials, grout mix, equipment and operational procedures to accomplish each grouting operation. Description may include sketches as appropriate, indicating type and location of mixing equipment, pumps, injection points, venting method, flow lines, pressure measurement, volume measurement, grouting sequence, schedule and stage volumes. Tests and certifications shall have been performed within last twelve months (12 Mos) prior to date of submittal.
- C. Submit grout mix design report, including:
 1. Grout type and designation.
 2. Grout mix constituents and proportions, including materials by weight and volume.
 3. Grout densities and viscosities, including wet density at point of placement.
 4. Initial set time of grout.
 5. Bleeding, shrinkage/expansion.
 6. Compressive strength.
- D. For cellular grout, also submit the following:
 1. Foam concentrate supplier's certification of dilution ratio for foam concentrate.
 2. A description of proposed cellular grout production procedures.
- E. Maintain and submit logs of grouting operations indicating pressure, density and volume for each grout placement.

PART II: PRODUCTS

2.1 MATERIALS

- A. Grouting materials: Conform to Section 03300 – Structural Concrete, except as modified in the following paragraphs.
- B. Grout Type Applications.
 1. Grout for pressure grouting, backfill grouting and annular grouting: Sand-cement mortar mix.
 2. Grout for annular grouting of sanitary sewer: Low density (cellular) grout, unless otherwise approved by the Project Manager.
 3. Grout for filling space in manholes: Sand-cement mortar mix.
 4. Ground stabilization: Sand-cement mortar mix.

- C. Do not include toxic or poisonous substances in grout mix or otherwise inject such substances underground.

2.2 GROUT

- A. Develop one (1) or more mixes based on following criteria as applicable:
 - 1. Size of annular void between sewer pipe and casing or size of void between casing and surrounding soil.
 - 2. Absence or presence of groundwater.
 - 3. Adequate retardation.
 - 4. Non-shrink characteristics.
 - 5. Pumping distances.
- B. Prepare mixes that satisfy required application. Provide materials conforming to the following standards:
 - 1. Cement: ASTM C150.
 - 2. Water: Potable.
 - 3. Foam: ASTM C869.
 - 4. Slurry: ASTM C138.
 - 5. Cellular Grout: ASTM C138.
 - 6. Sand for sand-cement mortar mix: ASTM C144.
- C. Provide grout meeting the following minimum requirements:
 - 1. Minimum twenty-eight day (28 D) unconfined compressive strength: one thousand five hundred pounds per square inch (1500 psi) for water lines, one thousand pounds per square inch (1000 psi) for other carrier pipes for mortar grout and three hundred pounds per square inch (300 psi) for cellular grout.
 - 2. Determine strength by ASTM C942.
 - 3. Maximum allowable density: Less than one hundred thirty pounds per cubic foot (130 pcf).
- D. Fluidifier: Provide fluidifier, meeting ASTM C937 that holds solid constituents of grout in colloidal suspension and is compatible with cement and water used in grouting operations.
- E. Admixtures.
 - 1. Use admixtures meeting ASTM C494 and ASTM C1017 as required, to improve pump ability, control time of set, hold sand in suspension and reduce segregation and bleeding.
 - 2. For cellular grout, do not use foam or admixtures that promote steel corrosion.
 - 3. Ensure that admixtures used in mix are compatible. Provide written confirmation from admixture manufacturers of their compatibility.

PART III: EXECUTION

3.1 PREPARATION

- A. Notify the Project Manager at least twenty-four hours (24 Hrs) in advance of grouting operations.

- B. Select and operate grouting equipment to avoid damage to new or existing underground utilities and structures.
- C. In selection of grouting placement consider pipe flotation, length of pipe, length of tunnel, depth from surface and type of sewer pipe, type of pipe blocking and bulkheading, grout volume and length of pipe to be grouted between bulkheads.
- D. Operate dewatering systems until grouting operations are complete and grout has reached initial set.

3.2 EQUIPMENT

- A. Batch and mix grout in equipment of sufficient size and capacity to provide necessary quality and quantity of grout for each placement stage.
- B. Use equipment for grouting of type and size generally used for the Work, capable of mixing grout to homogeneous consistency and providing means of accurately measuring grout component quantities and accurately measuring pumping pressures. Use pressure grout equipment which delivers grout to injection point at steady pressure.

3.3 ANNULAR GROUTING FOR SEWER/WATER LINE IN CASED OR UNCASED AUGERS

- A. Fill annular space between sewer pipe and casing or ground, with grout.
- B. Placement:
 - 1. Placement Limits: Predetermine limits of each grout placement stage by size and capacity of batching equipment and initial set time of proposed grout. Under no circumstances shall placement continue at grout port longer than that period of time for mix to take initial set. Locate grout hole spacing and locations according to number of stages necessary to grout tunnel liners. Stage or lift cannot be installed on another lift until proper set has been attained and placement procedures approved by admixture or additive manufacturer.
 - 2. Limit pressure on annular space to prevent damage or distortion to pipe. Define limiting and estimated required pressure range. Provide an open ended, high point tap or equivalent vent and monitor it at bulkhead opposite to point of grouting.
 - 3. Pump grout until material discharging is similar in consistency to that at point of injection.
- C. Remove temporary bulkheads installed for grouting.
- D. Batch and mix cellular grout mechanically to ensure consistency of mix. Wet solids thoroughly before introduction of foaming agent. Operate batching system to maintain slurry weight within three percent (3%) of design density. Introduce foam into slurry in accordance with manufacturer's recommendations.

3.4 PRESSURE GROUTING FOR JACKED PIPE

- A. For jacked pipe sixty inches (60 in) in diameter or greater, pressure grout annulus after installation, displacing bentonite lubrication. Jacked pipes

less than sixty inch (60 In) diameter may be left ungrouted unless excavated diameter exceeds external pipe diameter by more than one inch (1 In).

- B. Inject grout through grout holes in sewer pipe. Drilling holes from surface or through carrier pipe walls is not allowed. Perform grouting by injecting it at pipe invert with bentonite displacement occurring through high point tap or vent.
- C. Control ground water as necessary to permit completion of grouting without separation of grout materials.
- D. Limit pressures to prevent damage or distortion to pipe or to keep flexible pipe within acceptable tolerances.
- E. Pump grout until material discharging is similar in consistency to that at point of injection.

3.5 GROUND STABILIZATION GROUTING

- A. Completely fill voids outside limits of excavation caused by caving or collapse of ground. Fill with gravity or pressure injected sand-cement grout as necessary to fill void.
- B. Take care in grouting operations to prevent damage to adjacent utilities or public or private property. Grout at pressure that shall not distort or imperil portion of the Work or existing installations or structures.
- C. Verify that void has been filled by volumetric comparisons and visual inspection. In case of settlement under existing slabs, take cores as directed by the Project Manager, at no additional cost to the City, to demonstrate that void has been filled.

3.6 FIELD QUALITY CONTROL

- A. Annular Grouting for Sewer Line in Cased or Uncased Augers.
 - 1. Make one (1) set of four (4) compressive test specimens for every two hundred feet (200 Ft) of sewer pipe installed in primary lined tunnel.
 - 2. For cased or uncased augers, make one (1) set of four (4) compressive test specimens for each grouting operation or for each one hundred feet (100 Ft) of pipe installed, whichever is more frequent.
 - 3. For cellular grout, check slurry density both at point of batching and placement at least twice each hour in accordance with ASTM C138. Record density, time and temperature. Density must be within three percent (3%) of design density at point of batching and five percent (5%) of design density at point of placement.
- B. Pressure Grouting for Jacked Pipe. Make one (1) set of four (4) compressive test specimens for every four hundred feet (400 Ft) of jacked pipe pressure grouting.
- C. Ground Stabilization Grouting. Make one (1) set of four (4) compressive test specimens for every location where ground stabilization grouting is performed.

- D. All testing to be done in conformance with Section 01470 – Testing Laboratory Services and Section 01475 – Quality Control Testing Procedures.

END OF SECTION

SECTION 03010 REINFORCING STEEL

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Furnishing, fabrication and installation of all reinforcing bar, and for placement in concrete.
- B. Requirements for placing, tying and supporting reinforcing steel in concrete.

1.2 MEASUREMENT AND PAYMENT

A. UNIT PRICES:

- 1. No separate payment shall be made for reinforcing steel used as part of a new cast-in-place structure or concrete paving. Include cost for labor, materials and equipment in the cost of the bid item for the structure or paving.
- 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum):

- 1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

A. ACI – American Concrete Institute.

- 1. ACI 318-18 – Building Code Requirements for Reinforced Concrete and Commentary.
- 2. ACI SP-66 – Detailing Manual.

B. AWS – American Welding Society.

- 1. AWS – D1.4 – Structural Welding Code -Reinforcing Steel.

C. ASTM – American Society for Testing and Materials.

- 1. ASTM A82 – Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- 2. ASTM A185 – Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement.
- 3. ASTM A497 – Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete Reinforcement.
- 4. ASTM A615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- 5. ASTM A706 – Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
- 6. ASTM A767 – Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
- 7. ASTM A775 – Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

- D. CFTS – City of Friendswood Technical Specifications.
- E. CRSI – Concrete Reinforcing Steel Institute.
 - 1. Placing Reinforcing Bars.
 - 2. Manual of Standard Practice.
- F. ICBO – International Conference of Building Officials.
 - 1. ICBO Research Report.
- G. WRI – Wire Reinforcement Institute.
 - 1. Manual of Standard Practice, Welded Wire Reinforcement.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Action Submittals:
 - 1. Shop Drawings prepared in accordance with CRSI Manual of Standard Practice and ACI SP-66 Detailing Manual:
 - a. Bending lists.
 - b. Placing drawings.
- C. Informational Submittals:
 - 1. Lab test reports for reinforcing steel showing stress-strain curves and ultimate strengths.
 - 2. Mechanical Threaded Connections:
 - a. Current International Conference of Building Officials (ICBO) Research Report or equivalent code agency report listing findings to include acceptance, special inspection requirements, and restrictions.
 - b. Manufacturer's instructions.
 - c. Verification that device threads have been tested and meet requirements for thread quality, in accordance with manufacturers published methods.
- D. Welding Qualification: Prior to welding, submit welder qualifications and nondestructive testing procedures.
- E. Test results of field testing.
- F. Shop drawings shall show all bars, sizes, dimensions, spacings, clearances, and placement patterns.

1.5 QUALITY ASSURANCE

- A. Provide manufacturer's affidavits that steel was manufactured in compliance with standards referenced in this Section.
- B. Provide manufacturer's affidavits that steel is American made and not imported.
- C. Welder Qualifications: Certified in accordance with AWS D1.4.
- D. Independent Testing Laboratory, contracted by the City, shall inspect all items that are welded and shall report results to the Project Manager.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Unload, store, and handle bars in accordance with CRSI publication "Placing Reinforcing Bars."

- B. Reinforcing steel shall not remain on the ground for any length of time.

PART II: PRODUCTS

2.1 MATERIALS

- A. Deformed Billet-Steel Reinforcing Bars:
 - 1. Includes stirrups, ties, and spirals.
 - 2. ASTM A615, Grade 60, where welding is not required.
 - 3. ASTM A706/A706M, Grade 60, for reinforcing to be welded.
 - 4. ASTM A767/767M, Grade 60, for galvanized bars.
- B. Mechanical Splices and Connections:
 - 1. Metal Sleeve Splice: Furnish with cast filler metal, capable of developing, in tension or compression, one hundred twenty-five percent (125%) of minimum tensile strength of bar. Manufacturer and Product:
 - a. Erico Products, Inc., Cleveland, OH, Cadweld T-Series.
 - 2. Mechanical Threaded Connections: Furnish metal coupling sleeve with internal threads engaging threaded ends of bars developing in tension or compression one hundred twenty-five percent (125%) of yield strength of bar. Manufacturers and Products:
 - a. Erico Products, Inc., Cleveland, OH; Lenton Reinforcing Steel Couplers.
 - b. Richmond Screw Anchor Co., Inc., Fort Worth, TX; Richmond DB-SAE Dowel Bar Splicers.
- C. Welded Wire Reinforcement:
 - 1. ASTM A185 or A497 and ACT 31 8/318R, using ASTM A82 wire of seventy-five kilo-pounds per square inch (75 ksi) minimum tensile strength.
 - 2. Furnish flat sheets only; rolled sheets shall not be permitted.

2.2 ACCESSORIES

- A. Tie Wire:
 - 1. Black, soft-annealed sixteen (16) gauge wire.
 - 2. Nylon-, epoxy-, or plastic-coated wire.
- B. Bar Supports and Spacers:
 - 1. Precast concrete bar supports, cementitious fiber-reinforced bar supports, or all-plastic bar supports and side form spacers meeting requirements of CRSI Manual of Standard Practice. Other types of supports or spacers shall not be permitted.
 - 2. In concrete exposed to view after form removal: Small rectangular concrete blocks made up of same color and strength as concrete being placed around them, or all-plastic bar supports and side form spacers.
 - 3. Precast concrete supports of same strength as concrete for reinforcing in concrete placed on grade.

03010-3

4. Plastic Bar Supports: As manufactured by Aztec Concrete Accessories, Bloomington, CA.

2.3 FABRICATION

- A. Follow CRSI Manual of Standard Practice.
- B. Bend bars cold.

PART III: EXECUTION

3.1 PREPARATION

- A. Notify the Project Manager when reinforcing is ready for inspection and allow sufficient time for inspection prior to placing concrete.
- B. Clean reinforcing bars of loose mill scale, oil, earth, and other contaminants.
- C. Coat wire projecting from precast concrete bar supports with dielectric material, epoxy, or plastic.

3.2 REINFORCING BAR INSTALLATION

- A. Bundle or space bars, instead of field bending, where construction access through reinforcing is necessary.
- B. Spacing and Positioning: Conform to ACI 381/318R. There shall be a minimum of one inch (1 In) spacing between end of reinforcing bars and the face of the form.
- C. Location Tolerances: In accordance with CRSI publication, "Placing Reinforcing Bars".
- D. Splicing:
 1. Follow ACI 318/1318R.
 2. Use lap splices of not less than eighteen inches (18 In), unless otherwise shown on the Drawings or unless other methods are permitted in writing by the Project Manager.
 3. Stagger splices in adjacent bars where indicated.
- E. Mechanical Splices and Connections:
 1. Use only in areas specifically approved in writing by the Project Manager.
 2. Install threaded rods as recommended by manufacturer with threads totally engaged into coupling sleeve and in accordance with ICBO Research Report.
 3. For metal sleeve splice, follow manufacturer's installation recommendations.
 4. Maintain a minimum edge distance and concrete cover.
- F. Tying Reinforcing Bars:
 1. Tie every other intersection on mats.
 2. All edges shall be one hundred percent (100%) tied.
 3. No two (2) consecutive reinforcing bars in either direction shall

- be untied.
- 4. Bend ties wire away from concrete surface to provide clearance of one inch (1 In) from surface of concrete to tie wire.
- G. Reinforcing Steel Mat Supports.
 - 1. Reinforcing Steel Mat supports shall be either plastic, metal with plastic tips, or concrete brick only.
 - 2. Supports shall be of the size and height needed to maintain position of reinforcing steel in the concrete.
 - 3. Supports shall be installed underneath the crossing bar closest to the subgrade (bottom).
 - 4. Supports shall be placed in a checkerboard fashion similar to that for tying of the reinforcing steel.
- G. Reinforcement Around Openings: On each side and above and below pipe or opening, place an equivalent length and area of steel bars to replace steel bars cut for opening. Extend steel reinforcing a standard lap length beyond opening at each end.
- H. Straightening and Re-bending: Field re-bending of reinforcing steel bars is not permitted.
- I. Unless permitted by the Project Manager, do not cut reinforcing bars in the field.

3.3 WELDED WIRE REINFORCEMENT INSTALLATION

- A. Use only where specifically shown.
- B. Extend reinforcement to within two inches (2 In) of edges of slab, and lap splices at least eighteen inches (18 In).
- C. Tie laps and splices securely at ends with tie wire, and at least every twenty-four inches (24 In).
- D. Place welded wire reinforcement on concrete blocks and rigidly support equal to that provided for reinforcing bars. Do not use broken concrete, brick, or stone.
- E. Follow ACI 318/1318R and current Manual of Standard Practice, Welded Wire Reinforcement.
- F. Do not use rolled fabric or flat mats that have been rolled. Install flat sheets only.

3.4 TESTS AND INSPECTION

- A. An independent testing agency shall be retained by the City to visually inspect and test reinforcing steel welds in accordance with AWS D1.4.
- B. An independent testing agency shall be retained by the City to inspect each mechanical splice and verify each component is installed in accordance with manufacturer's instructions and ICBO Research Report.
- C. Special inspection shall be provided by the City as indicated on the Drawings.

END OF SECTION

03010-5

SECTION 03015 STRUCTURAL CONCRETE

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Requirements for materials, proportioning, batching, mixing, delivery, and testing of Portland Cement Concrete to be used for concrete paving, concrete structures, and all other types of concrete construction.
- B. Requirements for furnishing, erecting and removing form work, constructing expansion, construction, and control joints.
- C. Requirements for placing, curing, protecting and finishing of concrete.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No payment will be made for concrete for utility construction under this Section. Include cost in applicable utility structure.
 - 2. Obtain services of and pay for certified testing laboratory to prepare design mixes.
 - 3. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 REFERENCES

- A. ACI – American Concrete Institute.
 - 1. ACI 117 – Standard Tolerances for Concrete Construction and Materials.
 - 2. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
 - 3. ACI 302.1R – Guide for Concrete Floor and Slab Construction.
 - 4. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 - 5. ACI 308 – Standard Practice for Curing Concrete.
 - 6. ACI 309R – Guide for Consolidation of Concrete.
 - 7. ACI 311 – Guide for Concrete Plant Inspection and Field Testing of Ready-Mix Concrete.
 - 8. ACI 315 – Details and Detailing of Concrete Reinforcement.
 - 9. ACI 318 – Building Code Requirements for Reinforced Concrete and Commentary.
 - 10. ACI 544 – Guide for Specifying, Mixing, Placing, and Finishing Steel Fiber Reinforced Concrete.
- B. ASTM – American Standards and Testing of Materials.
 - 1. ASTM A82 – Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

2. ASTM A185 – Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
3. ASTM A615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4. ASTM A767 – Standard Specifications for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
5. ASTM A775 – Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
6. ASTM A820 – Standard Specification for Steel Fibers for Fiber-Reinforced Concrete.
7. ASTM A884 – Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
8. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
9. ASTM C33 – Standard Specification for Concrete Aggregates.
10. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
11. ASTM C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
12. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
13. ASTM C138 – Standard Test Method for Unit Weight Yield and Air Content (Gravimetric) of Concrete.
14. ASTM C143 – Standard Test Method for Slump of Hydraulic Cement Concrete.
15. ASTM C150 – Standard Specification for Portland Cement.
16. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete.
17. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.
18. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
19. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
20. ASTM C309 – Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.
21. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
22. ASTM C595 – Standard Specification for Blended Hydraulic Cements.
23. ASTM C685 – Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
24. ASTM C618 – Standard Specification for Coal Fly Ash or Calcined Natural Pozzolan for Use in Concrete.
25. ASTM C1064 – Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
26. ASTM C1077 – Standard Practice for Laboratory Testing of Concrete and Concrete Aggregate for Use in Construction and

Criteria for Laboratory Evaluation.

- C. CFTS – City of Friendswood Technical Specifications.
- D. CRSI – Concrete Reinforcing Steel Institute.
 - 1. CRSI MSP-1 – Manual of Standard Practice.
 - 2. CRSI – Placing Reinforcing Bars.
- E. Federal Specifications.
 - 1. Federal Specification SS-S-210A – Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints.
- F. NRMCA – National Ready Mix Concrete Association
 - 1. Concrete Plant Standards.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit proposed mix design and test data prepared by a certified testing laboratory for each type and strength of concrete in Work.
- C. Submit laboratory reports prepared by independent testing laboratory stating that all material used in concrete mix design comply with requirements in this Section.
- D. Submit manufacturer's mill certificates for reinforcing steel. Provide specimens for testing when required by Project Manager.
- E. Submit certification from concrete supplier that all materials and equipment used to produce and deliver concrete comply with this Technical Specification.
- F. When required on The Drawings, submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details, and other pertinent information.

1.5 CONCRETE CLASSIFICATION AND USE

- A. Classifications of concrete are for specific use and material only. Compressive Strengths shall vary depending on Designs, Details and Individual Technical Specifications, but at a minimum shall meet the minimum requirements as Specified in TABLE 4.1 – CONCRETE CLASSIFICATION MINIMUM REQUIREMENTS.
- B. Class of concrete shall be identified as follows:
 - 1. Class A Concrete – Paving, drilled shafts, non-structural culverts, inlets, manholes, curb, curb and gutter, sidewalk, driveway, wheelchair ramp, pilot channel and slope paving.
 - 2. Class B Concrete – Paving, structural culverts, wingwall, headwall and bridge structures.
 - 3. Class C Concrete – Small signs, anchors, and pipe blocking.
 - 4. Class D Concrete – Seal slab.
 - 5. Class E Concrete – Prestressed concrete beams, boxes and traffic barriers.
 - 6. Class F – “High Early Strength” concrete for traffic surfaces only and only with approval of Director of Engineering.

1.6 HANDLING AND STORAGE

- A. Cement: Store cement off of ground in well-ventilated, weatherproof building to prevent deterioration or exposure to moisture. Different brands of cement or same brand from different sources shall not be used on the same project unless approved by the Director of Engineering.
- B. Aggregates: All aggregates shall be transported and stockpiled separately according to their sources and gradations. Aggregates shall be handled in accordance with ACI requirements to prevent segregation and loss of fines or contamination with foreign materials.
 - 1. If aggregates show segregation or the different grades become mixed, aggregates shall be re-screened before placing in the proportioning bins.
 - 2. Aggregates from different sources or different gradations shall be segregated to prevent intermixing. Mixing of aggregates in stockpiles shall not be permitted.
 - 3. No aggregate shall be transferred to proportioning bins when the moisture content of the aggregate is such that it will affect the accuracy of proportioning. Such aggregates shall be removed and stockpiled until a dry surface condition is obtained.

PART II: PRODUCTS

2.1 CONCRETE MATERIALS

- A. Portland cement concrete shall be composed of Portland cement fine aggregate, coarse aggregate, water and admixtures as approved by the Project Manager and shall be proportioned and mixed as specified in this Section.
- B. Cementitious Material:
 - 1. Portland Cement: ASTM C150, Type I/II, unless use of Type III is authorized by Project Manager; or ASTM C595, Type IP. For concrete in contact with sewage use Type II cement.
 - 2. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding four pounds per cubic yard (4 Lbs/Cy) alkali content in form of $\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$.
- C. Water: Clean, free from harmful amounts of oils, acids, alkalis, organic or other deleterious substances, and meeting requirements of ASTM C94. Water from municipal supplies approved by State agencies will not require testing, but water from other sources shall be tested before use in concrete.
 - 1. Tests shall be made in accordance with AASHTO T26. One gallon (1 Gal) shall be taken to qualified testing laboratory for testing.
 - 2. Water used in white Portland cement concrete shall be free from iron and other impurities which may cause staining or discoloration.
- D. Aggregate:
 - 1. Coarse Aggregate: ASTM C33. Unless otherwise indicated, use following ASTM standard sizes: No. 357 or No. 467; No. 57 or

- No. 67, No. 7. Maximum size: Not larger than one-fifth (1/5) of narrowest dimension between sides of forms, nor larger than three-quarters (3/4) of minimum clear spacing between reinforcing bars. Coarse aggregates shall meet the requirements as specified in TABLE 4.2 – COARSE AGGREGATE GRADATION in this Section.
- a. Coarse aggregate material shall be made of either durable crushed or uncrushed gravel, crushed stone having uniform quality throughout. All coarse aggregate material shall have a wear of not more than forty percent (40%).
 - b. Deleterious substance shall have a maximum permissible percentage by weight as specified in TABLE 4.3 – DELETERIOUS SUBSTANCES in this Section. Aggregate to be free from excess of salt, alkali, vegetable matter or other objectionable material either free or as adherent coating.
2. Fine Aggregate: ASTM C33. Fine aggregates shall meet the requirements as specified in TABLE 4.4 – FINE AGGREGATE GRADATION in this Section. Fine aggregates shall be sand or combination of sand and not more than fifty percent (50%) stone screenings.
- a. Sand shall be clean, hard, durable and uncoated grains.
 - b. Stone screenings shall be clean, hard, durable and uncoated fragments resulting from crushing of stone.
3. Determine potential reactivity of fine and coarse aggregate in accordance with Appendix to ASTM C33.
4. Mineral filler – The addition of stone dust and/or sand as filler in Portland Cement Concrete paving may be used when approved by the Project Manager. Stone dust and sand shall be of acceptable quality and cleanliness as a mineral filler to improve workability and plasticity of the concrete mixture, in amounts not to exceed fifteen percent (15%) of the weight of fine aggregate. When tested with standard laboratory sieves, the mineral filler shall meet the requirements as specified in TABLE 4.5 – MINERAL FILLERS in this Section. Fly Ash shall not be used as a filler unless approved by the Director of Engineering. If approval has been granted for use of Fly Ash, then fly ash shall conform to ASTM C618.
- E. Air Entraining Admixtures: An air entraining agent shall be required and shall conform to ASTM C260. Air entrainment shall be four percent (4%) plus or minus one percent ($\pm 1\%$) for all concrete classes and verified for conformity in the field by a certified testing laboratory. Concrete with air entrainment quantity of five percent and one-half (5.5%) to seven percent (7.0%) may be accepted on condition of passing twenty-eight day (28 D) compressive strength tests and approval of the Project Manager. Concrete with air entrainment quantity greater than seven percent (7%)

or less than two percent (2%) shall be rejected. Air content shall be determined by ASTM C138 or ASTM C173. No air entrainment shall be required for seal slabs.

- F. Chemical Admixtures:
 - 1. Water Reducers: ASTM C494, Type A.
 - 2. Water Reducing Retarders: ASTM C494, Type D.
 - 3. High Range Water Reducers (Superplasticizers): ASTM C494, Types F and G.
- G. Prohibited Admixtures: No admixtures containing calcium chloride, thiocyanate, or materials that contribute free chloride ions in excess of one tenth of a percent (0.1%) by weight of cement shall be used in concrete mixes.
- H. Fiber:
 - 1. Fibrillated Polypropylene Fiber:
 - a. Addition Rate: One and one-half pounds (1-1/2 Lbs) of fiber per cubic yard of concrete.
 - b. Physical Properties:
 - (1) Material: Polypropylene.
 - (2) Length: One-half inch (1/2 In) or greater.
 - (3) Specific Gravity: 0.91.
 - c. Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.
 - 2. Steel Fiber: Comply with applicable provisions of ACI 544 and ASTM A820.
 - a. Ratio: Fifty pounds (50 Lbs) to two hundred pounds (200 Lbs) of fiber per cubic yard of concrete.
 - b. Physical Properties.
 - (1) Material: Steel.
 - (2) Aspect Ratio [for fiber lengths of one-half inch (1/2 In) to two and one-half inch (2-1/2 In), length divided by diameter or equivalent diameter]: Thirty to One (30:1) – one hundred to one (100:1).
 - (3) Specific Gravity: 7.8.
 - (4) Tensile Strength: Forty kilo-pounds per square inch (40 ksi) – four hundred kilo-pounds per square inch (400 ksi).
 - (5) Young's Modulus: Twenty-nine thousand kilo-pounds per square inch (29,000 ksi).
 - (6) Minimum Average Tensile Strength: Fifty thousand kilo-pounds per square inch (50,000 psi).
 - (7) Bending Requirements: Withstand bending around one eighth inch (0.125 In) diameter mandrel to angle of ninety degrees Fahrenheit (90° F), at temperatures not less than sixty degrees Fahrenheit (60° F), without breaking.
- I. Curing Compounds: Type 2 white-pigmented liquid membrane-forming compounds conforming to ASTM C309.

2.2 PRODUCTION METHODS

- A. Use either ready-mixed concrete from a source approved by the Director of Engineering conforming to requirements of ASTM C94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C685.

2.3 MEASUREMENT OF MATERIALS

- A. Measure dry materials by weight, except volumetric proportioning may be used when concrete is batched and mixed in accordance with ASTM C685.
- B. Measure water and liquid admixtures by volume.

2.4 DESIGN MIX

- A. Use design mixes prepared by certified testing laboratory in accordance with ASTM C1077 and conforming to requirements of this Section. Design shall be based on the required over-design factor according to ASTM C94 and assuming a coefficient of variation equal to fifteen (15). The average of three (3) consecutive strength tests shall be equal to or greater than the specified strength. Classification shall meet the requirements as specified in TABLE 4.1 – CONCRETE CLASSIFICATION MINIMUM SPECIFICATIONS in this Section.
- B. Proportion of concrete materials shall be based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this Specification. Submit concrete mix designs to Project Manager for review and approval.
- C. Variations in proportions of concrete may be based on field experience or trial mixtures, in accordance with requirements at Section 5.3 of ACI 318, may be made, but only when approved by Project Manager.
- D. Proportioning of Portland Cement and water shall meet the requirements as specified in TABLE 4.1 – CONCRETE CLASSIFICATION MINIMUM SPECIFICATIONS in this Section.
- E. Add steel or polypropylene fibers only when called for on The Drawings or in another Section of these Technical Specifications.
- F. Determine air content in accordance with ASTM C138, ASTM C173 or ASTM C231.
- G. Once a design mix for any class of concrete has been approved by the Project Manager, the mix shall not be varied as to source, quantity, quality, grading of materials, proportioning of any other way except as allowed for moisture adjustment and tolerances as specified in ASTM C685.

PART III: EXECUTION

3.1 BATCHING AND MIXING

- A. Measure, batch, mix, and deliver ready-mixed concrete in accordance with ASTM C94, Sections 8 through 11. Produce ready-mixed concrete using automatic batching system as described in NRMCA Concrete Plant

Standards, Part 2 – Plant Control Systems.

- B. Measure, mix and deliver concrete produced by volumetric batching and continuous mixing in accordance with ASTM C685, Sections 6 through 8.
- C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of Project Manager before adjustment and change of mix proportions.
- D. Ready-mixed concrete delivered to site shall be accompanied by batch tickets providing information required by ASTM C94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing information required by ASTM C685, Section 14. Water withheld from the mix shall also be noted on the batch ticket. In addition to the referenced information, each batch ticket shall also include the design mix information so that the batch can be compared on site to the mix design.
- E. Clean, maintain and operate equipment so that it thoroughly mixes material as required.
- F. Moisture Control:
 - 1. At the time of batching, all aggregates shall have been dried or drained sufficiently to result in a stable moisture content such that no visible separation of water from aggregate will take place during transportation from the proportioning plant to the point of mixing.
 - 2. In no event shall the free moisture content of the fine aggregate at the time of batching exceed eight percent (8%) of its saturated, surface-dry weight. The batch-to-batch uniformity of all aggregates shall be such that variations in moisture content within one hour (1 Hr) do not exceed twelve pounds (12 Lbs) in the batch quantity for one cubic yard (1 Cy) of concrete, or that a gradual change does not exceed twenty-four pounds (24 Lbs) in a period of four hours (4 Hrs).
 - 3. The Contractor shall install, and maintain in operating condition, an electrically actuated moisture meter which will indicate on a readily visible scale the percentage of moisture in the fine aggregate as it is batched, within a sensitivity of one-half percent (1/2%) by weight of the fine aggregate.
- G. Scales
 - 1. Scales shall be used for the accurate measurement of each of the materials entering each batch of concrete.
 - 2. If scales are of the dial type, the dial shall be of such size and so arranged that it may be read easily from the operating platform.
 - 3. If scales are of the multiple beam type, the scales shall be provided with an indicator operated by the main beam which will give positive visible evidence of over or underweight. The indicator shall be so designed that it will operate during the addition of the last two hundred pounds (200 Lbs) of material of any weighing. The over-travel of the indicator hand shall be at least one-third (1/3) of the loading travel. Indicators shall be

enclosed to protect against moisture and dust.

4. Scales shall be tested by a commercial scale company and certified that the scales meet all requirement for weighing equipment. Certification shall be required whenever a scale is relocated, and at least once every six months (6 Mos). Copies of the certifications shall be provided to the Project Manager when requested.

H. Recorders

1. An accurate recorder shall be provided for producing a digital printout of the batch number and scale readings corresponding to each of the ingredients of each concrete batch, including zero (0) initial readings. The individual ingredients shall be indicated by name or code corresponding to each weight.
2. Each printout shall indicate date and time of batching, identification number identical to that of the concrete delivery ticket and codes for the mix design and of the Work.
3. The printout shall be prepared in duplicate, with one (1) copy delivered together with its corresponding concrete delivery ticket to the Project Manager, as specified herein before.
4. Each recorder mechanism shall be enclosed in a locked, dust tight cabinet and shall be placed in a position convenient for observation.

3.2 DELIVERY AND DELIVERY EQUIPMENT

- A. Hand-mixed concrete shall be made in batches not larger than one-third cubic yard (1/3 Cy) and only with approval of the Project Manager. Concrete shall be Sakrete or approved equal, no separate proportioning of materials outside of a batch plant will be allowed. Batching shall be in accordance with manufactures directions and stated measurements.
 1. Mixing of concrete shall be in a clean, water tight mixing box.
 2. Introduce measured amount of clean water.
 3. Mix water and cement a minimum of six (6) turns or until batch maintains uniform color and consistency.
 4. At no time shall bags of Sakrete be put in place, sliced open and water added in a ditch or hole.
- B. Pumping and pneumatic conveying equipment shall be of a suitable kind with adequate pumping capacity. Equipment shall be cleaned at the end of each operation. Pneumatic placement shall be controlled so that segregation does not occur in the discharged concrete. Concrete shall not be conveyed through any pipe made of aluminum or aluminum alloy.
- C. Transit mix trucks shall be in good working order. All trucks shall have the following operational, delivery and placing conditions and equipment:
 1. Actuated drum revolution counter shall be in good working order.
 - a. Batch shall be mixed at the plant between fifty (50) and seventy (70) revolutions before being transported to site.
 - b. At no time shall a batch be placed when mixed less than seventy (70) revolutions or more than 100 revolutions,

- except as noted in 3.2.C.1.c.
- c. Batch shall be mixed for a minimum of twenty-five (25) revolutions after additional water has been introduced into the mix on site. This procedure shall be repeated for each instance when water is added.
- 2. Water supply reserve tank shall be supplied on each truck.
 - a. Water tank shall be full on arrival at site.
 - b. Water tank shall have accurate scale to measure gallons of water to be introduced to truck mixer.
 - c. Project Manager shall verify the amount of water used on site for mixing and verify the recording on the trip ticket.
- 3. Drum mixer shall be watertight and shall be free of hardened concrete and shall have fins that are capable of thoroughly mixing concrete.
- 4. Any defective equipment that cannot meet the Specifications of 3.2.C shall not be allowed on site until the deficiencies have been corrected.

3.3 PLACING CONCRETE

- A. Give sufficient advance notice to the Project Manager [at least forty-eight hours (48 Hrs) prior to commencement of operations] to permit inspection of forms, reinforcing steel, embedded items and other preparations for placing concrete. Place no concrete prior to the Project Manager's approval.
- B. Schedule concrete placing to permit completion of finishing operations in daylight hours. However, when necessary to continue after daylight hours, site shall be illuminated completely as required. When rainfall occurs after placing operations are started, provide covering to protect work.
- C. Subgrade surface shall be sprinkled sufficiently with water to prevent absorption of water from freshly placed concrete.
- D. Forms and rebar shall be cleaned of all foreign materials; subgrade shall be free of all trash and other materials.
- E. Batches that do not have computer batch tickets or delivery tickets shall be refused. Once a truck has been refused for any reason it shall leave the site. Attempts to fix deficiencies on site shall not be allowed.
- F. Temperature specifications for placement of concrete shall be as follows and as specified in TABLE 4.6 – TEMPERATURE REQUIREMENTS FOR PLACEMENT in this Section:
 - 1. Ambient (Air) temperature shall be taken in the shade and shielded from direct sunlight and wind.
 - 2. Minimum ambient temperature for concrete placement shall be thirty-five degrees Fahrenheit (35° F) and rising. At no time shall concrete be placed when ambient temperature is below forty degrees Fahrenheit (40° F) and falling.
 - 3. Maximum ambient temperature shall be ninety degrees

- Fahrenheit (90° F). Addition of ice to concrete mix shall allow ambient temperature maximum to be one hundred degrees Fahrenheit (100° F), upon approval of the Project Manager.
4. Minimum concrete temperature shall be fifty degrees Fahrenheit (50° F).
 5. Maximum concrete temperature shall be ninety degrees Fahrenheit (90° F). Addition of ice shall permit the maximum temperature to be ninety-five degrees Fahrenheit (95° F). At no time shall any concrete be placed when concrete temperature exceeds ninety-five degrees Fahrenheit (95° F).
- G. When adverse weather conditions affect quality of concrete, postpone concrete placement. Protect placed concrete from temperatures below thirty-two degrees Fahrenheit (32° F) until concrete has cured for minimum of three days (3 D) at seventy degrees Fahrenheit (70° F) or five days (5 D) at fifty degrees Fahrenheit (50° F).
- H. Time constraints – Concrete shall be placed so that there is no more than one hour (1 Hr) of time elapsed from last discharge to next discharge. Addition of allowable dosage of water retardation agent shall extend time limit by one-half hour (1/2 Hr). Limit on time from batch to placement shall be as specified in TABLE 4.7 – TRANSPORTING TIME REQUIREMENTS in this Section.
- I. If no water has been withheld from the mix at the plant, then addition of water to mix on site shall not exceed two gallons per cubic yard (2 Gal/Cy) of concrete. If water has been withheld, then up to the amount withheld can be added upon approval of the Project Manager. Any additional water above that, but not to exceed two gallons per cubic yard (2 Gal/Cy), shall be added only with the approval of the Project Manager. At no time shall slump exceed mix design nor be more than one and one-half inches (1-1/2 In) less than specified slump. All water that has been added to the truck shall be written on the trip ticket and batch ticket by the Project Manager.
- J. Use troughs, pipes and chutes lined with approved metal or synthetic material for placing concrete so that concrete ingredients are not separated. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete. Allow no aluminum or aluminum alloy material to come in contact with concrete.
- K. Limit free fall of concrete to four feet (4 Ft). Do not deposit large quantities of concrete at one location so that running or working concrete along forms is required. Do not jar forms after concrete has taken initial set, and do not place strain on projecting reinforcement rods or anchor bolts.
- L. Use tremies for placing concrete in walls and similar narrow or restricted locations. Use tremies made in sections, or provide in several lengths, so that outlet may be adjusted to proper height during placing operations.
- M. Place concrete in continuous horizontal layers approximately twelve inches (12 In) thick. Place each layer while layer below is still plastic.
- N. Compact each layer of concrete with concrete spading implements and

mechanical vibrators of approved type and adequate number for size of placement. When immersion vibrators cannot be used, use form vibrators. Apply vibrators to concrete immediately after depositing. Move vibrator vertically through layer of concrete just placed and several inches into plastic layer below. Do not penetrate or disturb layers previously placed which have partially set. Do not use vibrators to aid lateral flow concrete. Closely supervise consolidation to ensure uniform insertion and duration of immersion.

- O. Handling and Placing Concrete: Conform to ACI 302.1R, ACI 304R and ACI 309R.

3.4 FIELD QUALITY CONTROL

- A. Testing shall be performed under provisions of Sections 01470 – Testing Laboratory Services and 01475 – Quality Control Testing Procedures.
- B. Unless otherwise directed by the Project Manager, the following minimum testing of concrete shall be required. Testing shall be performed by qualified individuals employed by approved independent testing laboratory, and conform to requirements of ASTM C1077.
 - 1. Take concrete samples in accordance with ASTM C172.
 - 2. Make one (1) set of compression test specimens for each mix design at least once per day and for each one hundred cubic yards (100 Cy) or fraction thereof. Make, cure and test specimens in accordance with ASTM C31 and ASTM C39.
 - a. Tests are representative random sampling of each one hundred cubic yard (100 Cy) unit placement of concrete. Passing or failure of compressive testing shall represent all one hundred cubic yard (100 Cy) for acceptance or deficiency.
 - 3. When taking compression test specimens, test each sample for slump according to ASTM C143, for temperature according to ASTM C1064, for air content according to ASTM C231, and for unit weight according to ASTM C138.
 - 4. Inspect, sample and test concrete in accordance with ASTM C94, Section 13, 14, and 15, and ACI 311-5R.
- C. Test Cores: Conform to ASTM C42.
- D. Testing High Early Strength Concrete: When Type III cement is used in concrete, specified seven day (7 D) and twenty-eight day (28 D) compressive strengths shall be applicable at three days (3 D) and seven days (7 D), respectively.
- E. Seven day (7 D) compressive strengths shall be seventy (70%) percent of twenty-eight day (28 D) strength requirement.
- F. If twenty-eight day (28 D) compressive strengths fail to meet class specified requirements, then those portions of structure represented by test specimens shall be replaced at no additional cost to City.

- G. Take one (1) slump test a minimum of every fifty cubic yards (50 Cy) of placement according to ASTM C143. Project Manager shall be authorized to have testing laboratory take slump on any questionable concrete.

3.5 FINISHING

- A. Burlap drag or transverse broom for finishing slab.
 - 1. Burlap Finish – Furnish four (4) plies of ten ounce (10 oz) burlap material fastened to bridge to form continuous strip of burlap full width of pavement. Maintain contact three foot (3 Ft) width of burlap material with pavement surface. Keep burlap drags clean and free of encrusted mortar. Burlap shall be dragged longitudinally (parallel) with the centerline of the roadway. Finish look shall be straight lined. Swoops, diagonals or ridges shall not be allowed.
 - 2. Broom Finish – Furnish brooms with either horsehair or synthetic fiber bristles. Straw bristles shall not be allowed. Keep bristles clean and free of encrusted mortar. Broom shall be dragged latitudinally (perpendicular) with the centerline of the roadway. Adequate combination of pressure and bristle thickness shall be used to provide medium to heavy texture. Finish look shall be straight lined. Swoops, diagonals or ridges shall not be allowed.
 - 3. Fire hose finishing shall not be allowed.
- B. Finishing for patches and structures shall conform to the following requirements.
 - 1. Patch honeycomb, minor defects and form tie holes in concrete surfaces with cement mortar mixed one part cement to two parts fine aggregate. Repair defects by cutting out unsatisfactory material and replacing with new concrete, securely keyed and bonded to existing concrete. Finish to make junctures between patches and existing concrete as inconspicuous as possible. Use stiff mixture and thoroughly tamp into place. After each patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off mortar flush with surface.
 - 2. Apply rubbed finish to exposed surfaces of formed concrete structures as noted on The Drawings. After pointing has set sufficiently, wet surface with brush and perform first surface rubbing with No. 16 carborundum stone, or approved equal. Rub sufficiently to bring surface to paste, to remove form marks and projections, and to produce smooth, dense surface. Add cement to form surface paste as necessary. Spread or brush material, which has been ground to paste, uniformly over surface and allow to reset. In preparation for final acceptance, clean surfaces and perform final finish rubbing with No. 30 carborundum stone or approved equal. After rubbing, allow paste on surface to reset; then wash surface with clean water. Leave structure with clean, neat and uniform-appearing finish.

- C. Finish tolerances shall be as follows:
1. Top concrete surface of sidewalks shall be true planes within one-quarter inch (1/4 In) in ten feet (10 Ft).
 2. Wheelchair ramps shall be held to tolerances as stated in Sections 02820 – Concrete Sidewalks and 02825 – Colored Concrete for Wheelchair Ramps.
 3. Roadway slabs parallel to the centerline shall be true planes within one-sixteenth inch (1/16 In) in ten feet (10 Ft).
 4. All other surfaces shall be true planes within one-quarter inch (1/4 In) in ten feet (10 Ft).
 5. All tolerances shall be checked with a steel edge that has zero (0) tolerance deviation.

3.6 CURING

- A. Comply with ACI 308. Cure by preventing loss of moisture, rapid temperature change and mechanical injury for period of seven (7) curing days when Type II or IP cement has been used and for three (3) curing days when Type III cement has been used. Start curing as soon as free water has disappeared from concrete surface after placing and finishing. A curing day is any calendar day in which temperature is above fifty degrees Fahrenheit (50° F) for at least nineteen hours (19 Hrs). Colder days may be counted when air temperature adjacent to concrete is maintained above fifty degrees Fahrenheit (50° F). In continued cold weather, when artificial heat is not provided, removal of forms and shoring may be permitted at end of calendar days equal to twice required number of curing days. However, leave soffit forms and shores in place until concrete has reached specified twenty-eight day (28 D) strength, unless directed otherwise by the Project Manager.
1. Moisture Cover Curing Method: The concrete surfaces to be cured shall be covered with specific moisture-retaining cover material placed in the widest practical width with sides and ends lapped at least three inches (3 In) and sealed by waterproofing tape or adhesive. All holes or tears that develop during curing period shall be repaired immediately. Minimum curing time for this method shall be seven days (7 D).
 2. Liquid Membrane Curing: The specified membrane curing compound shall be applied to damp concrete surfaces as soon as possible after the final finishing operations are complete, but in no case later than two hours (2 Hrs) after finishing. Curing compound shall be applied uniformly over the concrete surfaces by means of approved spray equipment in accordance manufacturer's instruction. No deformities (tear drop, pattern, etc.) shall be accepted. Should the cure coat be damaged from any cause during the curing period, damaged portions shall be repaired and recoated immediately with additional compound.
- B. Formed surfaces not requiring rubbed-finished surface shall be cured by leaving forms in place for full curing period. Keep wood forms wet during

curing period. Add water as needed for other types of forms. Non-structural concrete forms, upon approval of the Project Manager, may be removed after two days (2 D) and curing compound applied.

C. Rubbed Finish:

1. For formed surfaces requiring rubbed finish, remove forms as soon as practicable without damaging surface.
2. After rubbed-finish operations are complete, continue curing formed surfaces by using either approved curing/sealing compounds or moist cotton mats until normal curing period is complete.

D. Unformed Surfaces: Cure by membrane curing compound method.

1. After concrete has received final finish and surplus water sheen has disappeared, immediately seal surface with uniform coating of approved curing compound, applied at rate of coverage recommended by manufacturer or as directed by the Project Manager. Do not apply less than one gallon (1 Gal) per one hundred eighty square feet (180 Sf) of area. Provide satisfactory means to properly control and check rate of application of compound.
2. Thoroughly agitate compound during use and apply by means of approved mechanical power pressure sprayers equipped with atomizing nozzles. For application on small miscellaneous items, hand-powered spray equipment may be used. Prevent loss of compound between nozzle and concrete surface during spraying operations.
3. Do not apply compound to dry surface. When concrete surface has become dry, thoroughly moisten surface immediately prior to application of compound. At locations where coating shows discontinuities, pinholes or other defects, or when rain falls on newly coated surface before film has dried sufficiently to resist damage, additional coat of compound shall be applied at specified rate of coverage.

3.7 PROTECTION

- A. Protect concrete against damage until final acceptance by City.
- B. Protect fresh concrete from damage due to rain, hail, sleet, or snow. Provide protection while concrete is still plastic, and whenever precipitation is imminent or occurring.
- C. Do not backfill around concrete structures or subject them to design loadings until components of structure needed to resist loading are complete and have reached specified twenty-eight day (28 D) compressive strength, except as authorized otherwise by the Project Manager.
- D. Concrete pavement shall not be used before the twenty-eight day (28 D) compressive strength unless the seven day (7 D) compressive strength test has reached the twenty-eight day (28 D) strength requirement. Pavement can be used for light vehicles only after the twenty-eight day

(28 D) strength has been met. At no time shall any equipment or vehicles heavier than eight thousand pounds (8000 Lbs) GVW (Gross Vehicle Weight) be allowed on pavement before it passes the twenty-eight day (28 D) compressive strength tests.

3.8 REMOVAL OF FORMS AND SHORING

- A. Remove forms from surfaces requiring rubbing only as rapidly as rubbing operation progresses. Remove forms from vertical surfaces not requiring rubbed-finish when concrete has aged for required number of curing days. When curing compound is used, do not remove forms before during first (1st) two (2) full days after concrete placement.
- B. Leave soffit forms and shores in place until concrete has reached specified twenty-eight day (28 D) strength, unless directed otherwise by the Project Manager.

3.9 DEFECTIVE WORK

- A. Immediately repair defective work discovered after forms have been removed. When concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove and replace entire section.

PART IV: TABLES

4.1 CONCRETE CLASSIFICATION MINIMUM SPECIFICATIONS

CONCRETE CLASSIFICATION MINIMUM SPECIFICATIONS					
Class of Concrete	Sacks of Cement per Cubic Yard Minimum	Minimum Compressive Strength at 28 Days	Maximum Cement to Water Ratio	Coarse Aggregate Grade Number	Slump
A	5.0	3000**	6.25	2 – 3	3 – 5*
B	6.0	3600**	6.00	1,2,3,4,5	4
C	4.0	2000**	8.00	2,3,4,5,6,7	5
D	6.0	3000**	6.00	2,3,4,5	5
E	6.0	As specified	5.50	3,4,5,6	5
F	8.75	5500**	3.6	6	5

*When ASTM C494, Type F or Type G admixture is used to increase workability, this range may be 6 to 9.

**These are minimum compressive strengths; please note a mix design is required for various applications to ensure specified compressive strengths are met for their intended use.

4.2 COARSE AGGREGATE GRADATION

COARSE AGGREGATE GRADATION CHART										
Aggregate Grade No.	Nominal Size Inches	Percent Retained on Each Sieve								
		2-1/2 In.	2 In.	1-1/2 In.	1 In.	3/4 In.	1/2 In.	3/8 In.	No. 4	No. 8
1	2	0	0-20	15-50		60-80			95-100	
2 (467)*	1-1/2		0	0-5		30-65		70-90	95-100	
3	1-1/2		0	0-5		10-40	40-75		95-100	
4 (57)*	1			0	0-5		40-75		90-100	95-100
5 (67)*	3/4				0	0-10		45-80	90-100	95-100
6 (7)*	1/2					0	0-10	30-60	85-100	95-100
7	3/8						0	5-30	75-100	
8	3/8						0	0-5	35-80	90-100

* Numbers in parenthesis indicate that the gradations conform to Corresponding ASTM gradation in ASTM C33.

4.3 DELETERIOUS SUBSTANCES

MAXIMUM PERMISSIBLE PERCENTAGES	
Deleterious Material	Maximum Percentage
Material removed by decantation, ASTM C117	1.0 %
Shale, slate or similar materials	1.0 %
Clay lumps	0.25 %
Soft fragments	3.0 %
Others, including friable, thin, elongated or laminated pieces	3.0 %

Sum of all deleterious ingredients, exclusive of material removed by decantation shall not exceed 5 % by weight.

4.4 FINE AGGREGATE GRADATION

FINE AGGREGATE GRADATION CHART								
Aggregate Grade No.	Percent Retained on Each Sieve							
	3/8 In.	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
1	0	0-5	0-20	15- 50	35- 75	65- 90	90-100	97-100

4.5 MINERAL FILLERS

MINERAL FILLER GRADATION CHART		
Percent Retained on Each Sieve		
No. 20	No. 30	No. 100
0 %	0 to 5 %	0 to 30 %

4.6 TEMPERATURE REQUIREMENTS FOR PLACEMENT

PLACEMENT TEMPERATURE REQUIREMENTS	
AMBIENT TEMPERATURE ¹	
Minimum temperature to start placing concrete	35° and rising
Minimum temperature to stop placing concrete	40° and falling
Maximum temperature for placing concrete without ice	90°
Maximum temperature for placing concrete with ice	100°
CONCRETE TEMPERATURE	
Minimum concrete temperature	50°
Maximum concrete temperature without ice	90°
Maximum concrete temperature with ice	95°
MINIMUM CURING TIMES WHEN PLACED CONCRETE HAS BEEN EXPOSED TO FREEZING TEMPERATURES	
From 50° to 70°, minimum days	5
70° and above, minimum days	3
¹ Ambient temperature is to be taken as specified in paragraph 3.3.F.1 of this Section.	

4.7 TRANSPORTING TIME REQUIREMENTS

TRANSPORTING TIME REQUIREMENTS FOR PLACEMENT		
Ambient Temperature	Maximum Time (No Retarding Agent) in Minutes	Maximum Time (With Retarding Agent) in Minutes ¹
Non-Agitated Concrete		
Above 80° F	15	30
80° F and Below	30	45
Agitated Concrete		
Above 90° F	45	75
75° F to 90° F	60	90
75° F and Below	90	120
NOTE: Time interval shall be from the addition of cement to the batch to start of placement of concrete in the forms. ¹ Normal Dosage of retarder.		

END OF SECTION

**TECHNICAL SPECIFICATIONS
FOR
CITY OF FRIENDSWOOD
LIFT STATION #2 REHABILITATION**

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TBPE FIRM NO. F-26942



TABLE OF CONTENTS

DIVISION 03 – CONCRETE

Pre-Stressed Concrete Poles	03400

DIVISION 13 – SPECIAL CONSTRUCTION

Measurement and Control Instrumentation	13400

DIVISION 16 – ELECTRICAL

Electrical Systems Testing and Startup	16004
Electrical Selective Demolition	16020
Basic Electrical Materials and Methods	16050
Basic Electrical Submittal and O&M Requirements	16051
Electrical Identification	16052
Grounding and Bonding	16060
Low-Voltage Conductors and Cables	16121
Raceways and Boxes	16131
Conduit Fittings and Bodies	16132
Underground Ductbank	16133
Electrical Utility Service	16211
Short Circuit Coordination Study – Arc Flash Hazard Analysis	16212
Automatic Transfer Switch	16261
Enclosed Switches and Circuit Breakers	16410
Surge Suppression	16415
Motor Controllers	16420
Motor Control Center	16432
Control Panel	16433
Panelboards	16438
Pilot & Control Devices	16441
Low-Voltage Transformer	16460
Network Equipment	16710
Cellular Equipment	16772
Power Monitor	16911
PLC SCADA Equipment	16950

END OF SECTION

Section 03400 Prestressed Concrete Poles

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. This specification is to establish design and quality standards for static cast concrete poles for power distribution, lighting, and security mounting equipment
- D. All pole design structural calculations shall be prepared by a licensed engineer experienced in prestressed concrete design and wind loading calculations

1.2 PRICE AND PAYMENT PROCEDURES

- A. Items inclusive of the requirements of this section are to be included in the bid price. Item may be part of general electrical work or standalone bid item. This item will be paid on a fixed price basis for all related equipment as shown on contract drawings, located within the project limits of construction, and specified herein. Fixed price shall include poles, foundation, grounding, light fixtures, electronic enclosures, and all other accessories as shown in the contract documents

1.3 REFERENCES

- A. Refer to other technical specifications for this project including:
 - 1. 13100 – Lightning Protection
 - 2. 16050 – Basic Electric Materials and Methods
 - 3. 16051 – Basic Electrical Submittal and O&M Requirements
 - 4. 16060 – Grounding and Bonding
 - 5. 16211 – Electrical Utility Service
 - 6. 16520 – Exterior Lighting
 - 7. 17050 – Basic Security Materials and Methods
 - 8. 17051 – Basic Security Submittal and O&M Requirements
 - 9. 17100 – Surveillance Camera System
- B. Not all references may be shown. Refer to other technical specifications in section 1.03 (A)
- C. Relevant references may include all shown below:
 - 1. National Electrical Code (NEC)

2. Underwriters Laboratories (UL)
3. National Fire Protection Association (NFPA) 70E – “Standards for safety in the workplace”
4. American National Standard Institute (ANSI)
5. Institute of Electrical and Electronic Engineers (IEEE)
6. ACI-318 – Building Code Requirements for Structural Concrete
7. ASCE-7 – Minimum Design Loads for Buildings and Other Structures
8. 2018 – International Building Code (IBC)
9. PCI Design Handbook – Precast/Prestressed Concrete Institute
10. Prestressed Concrete Institute – Guide for Design of Prestressed Concrete Poles
11. Concrete Reinforcing Institute – Manual of Standard Practice
12. American Society for Testing Materials (ASTM)
 - a. C105 – Portland Cement
 - b. C150 – Standard Specification for Type I and Type II Low Alkali Portland Cement
 - c. C33 – Standard Specification for Concrete Aggregates
 - d. C330 - Aggregates
 - e. C494 - Admixtures
 - f. A36 – Standard Specification for Carbon Structural Steel
 - g. A82 – Cold Drawn Spiral Wire
 - h. A416 – Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete (270K)
 - i. A615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - j. A706 – Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

1.4 SUBMITTALS

- A. Refer to referenced specifications for Basic Submittal and O&M Requirements
- B. Concrete pole structural calculations, wind load calculations, and installation recommendations shall be prepared and sealed by licensed engineer as part of this work
- C. Furnish detailed design drawing and computations for the pole supplied, including, but not limited to the following for review:
 1. Calculated weight of each concrete pole
 2. Center of gravity of each pole
 3. Calculations of cracking and ultimate moment capacities at not more

than 5-foot intervals

4. Dunnage and pickup points, including both one-point and two-point pickup locations
5. Detail of cross section and all points where reinforcing changes.
6. Section and strength properties including the ultimate
7. Cracking and zero tension moments and deflections at maximum 5-foot intervals along the pole.
8. Pole diameter at top, bottom, and ground line
9. Tip and butt wall thickness
10. Pre-stress strand; quantity, size, and dropout location
11. 28-day compressive strength of concrete
12. Diameter taper (inch/feet)
13. Installation depth and direct embedment recommendations
14. Wind loading calculations
15. Warranty certificates
16. Testing reports

PART II: PRODUCTS

2.1 PRESTRESSED CONCRETE POLE

- A. Standard class prestressed concrete poles suitable for direct embedment into the ground without special foundations shall be provided. Provide shall be one (1) piece construction and have access handholes in wall
- B. Pole shall be provided with PVC conduit cast in pole to allow for installation of conductors and cables as specified in plan drawings
- C. Wind loading strength: 150 mph and 1.3 gust factor for total support assembly, pole, supports, and attached appurtenances at indicated height above grade
- D. Concrete pole structural calculations, wind load calculations, and installation recommendations shall be prepared and sealed
- E. Poles shall be supported and protected during site storage, lifting and setting to prevent damage to the pole. Spalls or other damage incurred during these operations shall be repaired to restore the pole to "as new" condition

2.2 PHYSICAL CHARACTERISTICS

- A. Shape and Length: Poles shall be square in cross-section, with chamfered

- corners, and shall have a standard taper of 0.162 inch per foot. Cross-sectional dimensions shall not deviate by more than 3/8 inch. The allowable tolerance for overall length shall be plus 3 inches and minus 2 inches. The width of the bottom face of the pole may be less than the top face
- B. Finish: The pole shall have a smooth uncolored finish with no cracks. The top surface of each pole shall be troweled until all projections, depressions, and irregularities have been removed and the entire surface has a smooth texture and neat lines. Square corners and sharp edges shall be tooled to form smooth, chamfered corners. All small cavities shall be cleaned, saturated with water, and then filled with mortar. A small cavity is defined as one larger than 1/4 inch but smaller than 3/4 inch in diameter, and less than 3/8 inch deep. Larger non-structural cavities and spalls shall be repaired by opening the side of the damaged area on a 1 to 1 slope using a mechanical grinder, cleaning thoroughly and filling with a high strength non-shrink concrete repair material. Poles with other defects may be repaired only upon authorization of, and using the method prescribed by the Design Engineer
- C. Sealing Steel Strands: The end of each steel reinforcing strand (in the top and butt) shall be burned back to a minimum depth of 1/2 inch. The holes left by the removal of the strand shall be thoroughly cleaned of any loose residue. The holes shall then be filled with non-shrink grout and smoothed evenly with tip or butt surface
- D. Cover: The prestressing strands shall have a minimum concrete cover of 1 inch, except that Type I poles will have a minimum cover of 3/4 inch. The centerline axis along the faces of the poles shall be clear of embedded steel except for stirrups, spiral reinforcement and fabrication devices, so that 3/4-inch diameter holes may be drilled without interference from the strands
- E. Sweep: Sweep is the deviation of a pole from straightness. A straight line joining the edge of the pole at the butt and the edge of the pole at the top shall not be distant from the surface of the pole at any point by more than 3/8 inch for each 10 feet of length
- F. Hole Drilling: Poles shall be drilled in accordance with approved drawings. The location of holes shall not deviate by more than 3/8 inch. Holes drilled after removal from molds shall be drilled from both sides of the pole and shall be uniform in entrance and exit. Holes drilled from opposing sides of the pole must be in the same plane and be centered on both faces
- G. Cable Entrances: Two (2) cable entrances with couplings shall be cast in all 90 degrees to the handhole unless otherwise specified. Refer to plans for additional requirements
- H. Handhole: Provide handhole with metal cover plate to act as junction box for conductor installations

2.3 STRENGTH REQUIREMENTS

- A. Poles of each standard type, unless otherwise specified, shall be designed to withstand the rated design (cracking) and ultimate strength, with modifications to accommodate allowances for handling, transportation, and erection. The rated strength is that load which, if applied, in a direction perpendicular to the axis 2 feet below the pole tip and with the bottom of the pole (10 percent of its length plus 2 feet from the butt) held firm, will produce the first sign of hairline cracks. The ultimate strength is the load at which point failure occurs
- B. All poles shall be capable of withstanding single point pickup from the horizontal position when lifting from a point 30 percent of the overall length down from the tip

2.4 MATERIALS

- A. Chloride content: The chloride content of the concrete mix, including all ingredients, shall be 0.4 pounds per cubic yard, or less
- B. Corrosion resistance: All inserts or attachments, if required, shall be of non-corrosive material or galvanized
- C. Concrete: Concrete used in poles shall have a compressive strength at transfer of not less than 4,000 PSI, and a 28-day compressive strength of not less than 7,000 PSI, unless otherwise specified

PART III: EXECUTION

3.1 QUALIFIED MANUFACTURERS

- A. Lonestar Prestress Manufacturing Inc.
- B. Or approved equal

3.2 INSTALLATION

- A. Set units plumb, square, level, and secure according to manufacturer's written instructions and approved submittals
- B. Poles shall be supported and protected during site storage, lifting and setting to prevent damage to pole. Spalls or other damage incurred during these operations shall be repaired to restore the pole to "as new" condition

3.3 HANDLING AND INSTALLATION PROCEDURES

- A. Handling instructions:
 - 1. Prestressed concrete poles will withstand a considerable amount of bending but should not be shock loaded while under load

2. Prestressed concrete poles should never be handled or picked up by the tip
 3. When shipping poles, the poles should be supported at a minimum of three points for poles up to and including 40-feet and four points for poles over 40-feet
 4. Poles up to 50 feet in length may be unloaded using a one-point pickup at the balance point but should never be transported in this manner. A two-point pickup must be used to transport a pole at the job site
- B. Contractor will be responsible for conducting his own geotechnical investigation during the construction phase to finalize the foundation design
- C. Installation procedure:
1. Prior to installation of the pole, electrical wiring, luminaries, and equipment brackets can be installed while the pole is lying horizontally on the ground
 2. Excavate the proper diameter and depth hole per foundation show on drawings. Install reinforcing steel as shown on drawings, and pour foundation as appropriate during pole setting activities
 3. To install, choke the pole with one end of a nylon sling 25 percent to 30 percent of the pole length from the top (see "Handling Instructions" paragraph for location). Attach the other end of the sling to the lifting hook of the crane
 4. Lift the pole allowing the butt to rest on the ground until vertical
 5. Lift the pole over foundation and lower until butt rests on foundation
 6. While holding the pole, foundation pour around base of pole. Check for plumbness throughout the backfilling process
 7. If the pole is equipped for an underground connection, stop backfilling to a point 6-inches below the connection. Make the connection and then finish backfilling the hole to a point 2-inches above grade.

3.4 DIRECT EMBEDMENT

- A. Direct embedment is the most common and recommended method of installation of prestressed concrete poles. Soil conditions vary from location to location and should be investigated by an Engineer prior to designing the foundation. The "rule of thumb" for the depth of embedment is 10 percent of the overall length plus 2 feet. Depending upon the type of soil, an appropriate backfill should be selected. The chart below contains suggested guidelines for the selection of backfill:
1. Good Soil: Compacted well graded sand and gravel, hard clay or well graded fine and coarse sand. The excavated soil may be used as the backfill
 2. Medium Soil: Compacted fine sand and clay, compact sandy loam,

loose coarse sand and gravel. Requires select backfill. Clean, washed sand or minus ½ inch well graded gravel may be used

3. Poor Soil: Soft clay, clay loam, poorly compacted sand or clays containing large amounts of silt. Requires one of the following: cementitious earth, cement stabilized sand, limestone screenings or urethane foam

3.5 GROUNDING

- A. Refer to grounding specification for additional requirements
- B. A PVC conduit to pull ground wire through may be cast in pole if required

3.6 SITE QUALITY CONTROL

- A. INSPECT installed units for damage
- B. Replace or repair damaged poles
- C. Tests shall be made, and records shall be maintained, in accordance with the requirements of prestressed concrete institute MNL-116, "Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products"

END OF SECTION

Section 13400 Measurement and Control Instrumentation

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. This section covers field transmitters for instrumentation and control systems. Refer to complete plans and project manual for additional information on all transmitters described to be provided and installed

1.2 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.3 QUALITY ASSURANCE

- A. All equipment shown to be provided and installed shall be coordinated with each manufacturer for accuracy and relevance. Manufacturer shall be included in all testing, calibration, and substantial walkthrough prior to engineer final walkthrough

PART II: PRODUCTS

2.1 FLOAT SWITCH

- A. Wastewater / Non-Potable Use:
 - 1. Manufacturers:
 - a. Anchor Scientific
 - b. Pre-approved equal
 - 2. Construction:
 - a. Direct acting
 - b. Polypropylene body
 - c. Form C type contact mercury switch
 - d. 10 amps at 230 VAC maximum
- B. Float switches for control of indicated equipment shall consist of plastic encased ball-type float switch with weighted neck and three conductor plastic sheathed cord. Float switches shall be furnished with form C contacts.
- C. Furnish Flygt, Anchor-Scientific, or approved equal float switches.

2.2 SUBMERSIBLE LEVEL TRANSDUCER

- A. Non-Potable Water Application:
 - 1. Manufacturer:
 - a. Blue Ribbon
 - b. CA Briggs
 - c. Mercoid
 - d. Pre-approved equal
- B. Model: Blue Ribbon Bird Cage Water Level Sensor
- C. Power: 10 - 30 VDC
- D. Output: 4-20 mA
- E. Accuracy: plus/minus 0.1 percent of calibrated span, minimum
- F. Range: 0.2 to 100 meters of H₂O, minimum
- G. Sensor: Flush mounted ceramic
- H. Provide blue ribbon surge protector add-on for lifetime surge protection warranty. Include warranty documentation in O&M manuals
- I. Heavy stainless-steel body
- J. Cable: Heavy duty, submersible rated with strain relief device
- K. Cable Length: Wet well depth plus length to terminal box with 10 feet slack coiled in terminal box (not in wet wells)
- L. Kellum grip with protective bushing. Suspend on stainless steel cable clear of pump and 4 inches above intake. Clamp transducer cable to stainless steel cable with suitable stainless-steel clamps at 24-inch intervals
- M. Provide epoxy coated lead weight at end of stainless-steel cable. Provide stainless steel cable strain relief device at transducer that fits threaded connection at transducer, and that has ring for support by stainless steel cable

PART III: EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's written instructions and approved submittals.
- B. Set-up and calibration of equipment shall only be performed by a Factory Technician.

3.2 ADJUSTEMENT/CALIBRATION

- A. Provide services of a Factory Technician for calibration and programming of transmitters for range of variable with 4/20 mA representing 0 to 125 percent of maximum range. Allow for field adjustments during testing of installation

3.3 MAINTENANCE/WARRANTY

- A. Contractor shall provide full 3-year service warranty on the overall installation and shall include all labor and materials required to repair or replace equipment and/or components that are defective or malfunctioning
- B. All critical warranted repairs shall be made within 24 hours of receipt of required parts from Manufacturer with reasonable delivery time of overnight shipping. Any repairs not completed within 5 working days from date of notice are subject to Owner making other arrangements for repair and back charging Contractor. This requirement is a condition of this contract.
- C. Where equipment or instrument problems remain unresolved by Contractor beyond a reasonable time, a Factory Technician shall be provided on-site to take any corrective actions necessary to put equipment or instruments in operating order. Owner and Engineer reserve the right to determine a reasonable time for corrective action by Contractor.
- D. Any failed equipment may not be repaired and returned to service prior to final acceptance. Only new equipment is allowed.
- E. For all differential level transmitters used to measure level of hydro tanks, provide a diaphragm seal at the connection to the hydro tank to prevent water entry into the transmitter. Unit shall be rated for the pressure range of the transmitter and shall be stainless steel construction.

END OF SECTION

Section 16004 Electrical Systems Testing and Startup

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. Requirements for electrical system testing and startup are included in this section.

1.2 REFERENCES

- A. National Electrical Codes (NEC): NEC Article 110 - Requirements for Electrical Installations.
- B. International Electrical Testing Association (NETA): "NETA Acceptance Testing Specifications."

1.3 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051
- B. The name, address, and telephone number of the proposed testing company to be engaged for testing the electrical system, together with their references and samples of recent test results and reports
- C. The Contractor shall submit for approval a complete list, including catalog data and descriptive matter, of all products and equipment the Contractor proposes to furnish, and details as may be required by the Engineer to review proposed testing methods. At a minimum, the following are required.
 - 1. Samples of proposed test report forms for the various types of tests indicated herein prior to commencement of field testing.
 - 2. Test reports shall include but not be limited to the following: date, testing personnel names, temperature and humidity, description of item tested, type of tests performed, equipment used for testing, and test results.

PART III. PRODUCTS

2.1 MATERIALS, EQUIPMENT, AND PERSONNEL

- A. The Contractor shall provide the following:
 - 1. Qualified personnel to conduct all testing.
 - 2. Labor, temporary power, lighting, wiring, and materials required for testing.
 - 3. Submit nameplates and label legends as required in Section 16075 -

Electrical Identification. All abbreviations and titles shall be checked for clarity.

- B. Test Equipment: The third party testing agency shall furnish all test equipment, which shall include but not be limited to the following:
 - 1. Wet and dry bulb thermometer.
 - 2. Meggers by James G. Biddle Co., or Associated Research, Inc., or approved substitution, suitable for 120, 208, 240, and 480 volt and systems testing. Use instruments rated at voltages recommended by Material and Equipment Manufacturers.
 - 3. Portable radios.
 - 4. A Simpson Model 260 Volt-Ohm-Millimeter, or approved substitution.
 - 5. A phase sequence and rotation meters rated at 600 volts, 30-60 hertz, by Knopp, Inc., or approved substitution for the 120, 208, 240, and 480-volt systems.
 - 6. A commercial model, three point, ground test by James G. Biddle Co., a "Vibroground" tester by Associated Research, Inc., or approved substitution.
- C. The Contractor shall furnish and use safety devices such as rubber gloves and blankets, protective screens and barriers, danger signs, etc., to adequately protect and warn all personnel in the vicinity of the tests.
- D. Test equipment, material, and labor for electrical system testing execution. Test shall be by the outside testing agency engaged for this purpose.

PART III. EXECUTION

3.1 GENERAL

- A. All testing to be performed in compliance with NETA Acceptance Testing Specifications. All submitted test results must include statement indicating compliance.
- B. Prior to start of field testing the installation shall be completed, punch listed and inspected by the Engineer and/or Owner's Representative for satisfactory completion of work.
- C. Testing may be witnessed by the Engineer or Owner's Representative. Provide 1 week advanced notice accordingly.
- D. Where hard copy reports are generated, provide all original reports bound in a three (3) ring binder and assembled in a professional format. All reports shall be submitted to Engineer for review. Upon approval, any hard copies shall be left on site or turned over to Owner's Representative.

3.2 TESTING

- A. Molded Case Breaker Tests: The tests shall include the following:
 - 1. Check adjustable magnetic trip settings against nominal values.

2. Megger each pole for freedom from grounds.
3. Check connections and tighten as required.
- B. Tests on Motor Starters and Contactors: Tests shall include the following:
 1. Check equipment grounding to assure continuity of connections.
 2. Remove any blocking used for shipment.
 3. Check overload relays for proper current range with motor nameplate full load amperes. Adjust relays for manual or automatic reset.
 4. Check each magnet coil for proper operating voltage.
 5. Check auxiliary contacts for correct arrangement with coil de-energized; i.e.; normally open or normally closed.
 6. Megger each pole of the starter or contractor for freedom from grounds.
 7. Check fuses and/or circuit breakers for proper ratings as prescribed by the manufacturer for the actual motor supplied.
 8. Check overload heater relays or other overload protection for proper ratings as prescribed by the manufacturer.
 9. Check wiring connections and tighten as required
 10. Check secondary fuses for proper ratings for motor starter control power transformers.
- C. Inspection of Disconnect Switches:
 1. Inspect contacts, clean as required.
 2. Inspect arc chutes.
 3. Inspect fuses for proper rating, type, and size.
- D. Lighting System Tests:
 1. Test lighting systems for proper operation, for conformance with indicated switch control on the Drawings, for dimming, etc.
 2. Set time clocks with astronomical dials to turn "ON" at sunset and "OFF" at sunrise and test operation.
- E. 600-Volt Wire and Cable Tests:
 1. 600-volt wire shall be meggered with a 500-volt megger for one minute, and values must be approximately as listed as follows:

Conductor Capacity	Resistance
Amperes	Ohms
0 - 24	1,000,000
25 - 50	250,000
51 - 100	100,000
101 - 200	50,000
201 - 400	25,000
501 - 800	12,000
Over - 800	5,000

2. The above values shall be determined with switchboards, panel boards, fuse holders, switches, and over current devices in place. Devices containing semi-conductors, such as diodes, transistors, and other devices, which can be damaged by the megger shall not be connected during meggering. Motors and transformers shall not be connected during meggering. Wire and cable shall be meggered after installation, not on the reel.
3. Wiring to be meggered shall be limited to feeder wiring between main distribution equipment and power panels, branch circuit panels, motor control centers, individual pieces of mechanical equipment and other similar equipment. Wiring for mechanical equipment connected to branch circuit panels shall also be meggered. Branch circuit wiring for lighting and receptacles shall not be meggered.
4. The Contractor shall perform all phasing tests and shall make changes necessary to assure proper rotation of all motors, the correct phasing and phase sequence of all circuits susceptible of being paralleled, the proper polarity on all instrument transformer wiring, and such other phasing tests and changes as may be required for the equipment being connected under this Contract.

F. Panelboards:

1. Test breaker ON/OFF operation.
2. Test voltages between phase and phase to ground at:
 - a. Before incoming breaker.
 - b. After the incoming breaker at the bus.
 - c. At all feeder breaking.
3. Record all test results.

G. Miscellaneous Equipment Tests: Test all miscellaneous equipment for proper operation in accordance with equipment manufacturer's instructions.

3.3 SYSTEM STARTUP

H. Testing and Startup:

1. All elements of each electrical control system shall be confirmed to demonstrate that the total system satisfies all of the requirements of this Specification. The Contractor shall coordinate and schedule all of his testing and startup work with the Owner and Systems Integration Engineer.
2. Factory Tests: The electrical controls and all other associated hardware shall be tested via a full simulation at the factory, prior to shipment, to demonstrate that each component is operational and meets the requirements of these specifications. Manufacturer shall provide test routine program for shop testing of I/O wiring. Test results shall be certified, with written documentation provided to the Engineer upon test completion. Factory testing may be witnessed by the Engineer.
3. Field Tests: All electrical control system components shall be checked to verify that they have been installed properly and that all terminations have been made correctly. Witnessed field tests shall be performed on the complete system. Contractor shall provide a checklist for all electrical, control and instrumentation functions and send to Engineer for approval. Each function shall be demonstrated to the satisfaction of the Owner and Engineer on a item-by-item basis. Each test shall be witnessed and signed off by the Contractor and the Engineer upon satisfactory completion. The Contractor shall notify the Owner at least 2 weeks prior to the commencement date of the field tests. After tests are completed and with system fully operational, system shall run continuously for a period of 10 days without failure. Any failures shall be repaired and 10 day test shall start over again.
4. Start-up Testing will require a minimum of 10 working days after work is substantially complete, including loading of programs to local PLC. Provide 4 weeks' notice for program downloading by Programmer. This shall be accounted for in project schedule.
5. Prior to testing system, any PLC programs or HMI programs provided by other than the Systems Integration Engineer shall be furnished on CD for review by Engineer. Provide any special software necessary to run and test complete program.

END OF SECTION

Section 16020 Electrical Selective Demolition

PART I. GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. This section covers selective demolition of electrical equipment.

1.2 REFERENCES

- A. Temporary wiring of systems to maintain operation of facilities while undergoing modifications and demolition shall be provided in accordance with:
 - 1. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), No. 70 - National Electrical Code (NEC), Article No. 590 - Temporary Installations.

1.3 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051
- B. Submit all products covered under this section for Engineer's approval.
- C. Annotate existing drawings to sequence the demolition of systems, equipment removal, and temporary hook-ups.
- D. Schedule with Owner for required shutdowns to accommodate system demolition and installation of temporary facilities.
- E. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark "Complies" or "Non-Compliance" or "Exception" adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.4 QUALITY ASSURANCE

- A. Verify field measurements and circuiting arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation and existing record documents. Report any discrepancies to Engineer before disturbing existing installation.
- D. By beginning demolition, installer accepts existing conditions and warrants

that he will maintain service to equipment and items not scheduled or indicated for removal, and that he will return to the Owner all serviceable items and systems in good operating conditions.

- E. Before starting demolition, test installation and verify operating condition of all equipment that is to remain serviceable. Notify Owner in writing of any equipment that is not operable.

PART II. PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual Sections, or as required to complete work intended by plans and specification.
- B. The temporary electrical wiring and facilities shall be designed and constructed in strict compliance with NEC - Article No. 590.

PART III. EXECUTION

3.1 PREPERATION

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal as shown on plans.
- B. Coordinate utility service outages with Utility Company to provide continuous service to operating equipment.
- C. Where required, provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from the Owner at least one week before partially or completely disabling system. Minimize outage duration.
- E. All existing equipment that is to remain serviceable shall be covered and sealed to prevent dust or water intrusion.
- F. Where equipment, motor control centers, panels, and devices are to be removed or relocated and where wiring is to remain or be reused, trace out all wiring and tag conductors. Record data in "As-Built" drawings.
- G. Where equipment is to be reused and is disabled without power for a period of over 1 week, the equipment shall be stored in a dry location and a heater shall be installed inside the enclosure and remain activated until equipment is placed back in service.

3.2 DEMOLITION

- A. Demolish and extend existing electrical work as shown on plans, and as understood from observable conditions noted during the pre-bid site visit.

- B. Remove, relocate, and extend existing installations to accommodate new construction. This includes rerouting of underground duct banks and conduits that may not be documented on Owner's record drawings. Contractor is to allow for these conditions in bid price. Failure to do so is at Contractor's risk.
- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, plug conduit, and patch surfaces.
- E. 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.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment servicing utilization equipment that has been removed.
- H. Repair adjacent construction and finishes damaged during demolition and extension work.
- I. Maintain access to existing installations, which remain active. Modify installation or provide access panel as appropriate.
- J. Extend existing installations using materials and methods as specified for new work.
- K. Any existing equipment that is to remain serviceable and is damaged during demolition or during new work shall be repaired or replaced to Owner's satisfaction in working condition.

3.3 DISPOSAL AND SALVAGE

- A. Salvage electrical and instrumentation equipment removed from existing facilities for reuse as shown on plans.
- B. Material and equipment, which can be reused or salvaged, remains the property of the Owner unless specifically indicated in the Specifications or Drawings, or as designed by the Owner.
- C. Materials and equipment which cannot be reused or salvaged for Owner's use will be removed and disposed by the Contractor at approved disposal facility.
- D. Remove, seal, and store generators, motors, and other large equipment for Owner's use. Store at designated location wrapped in water and dust tight covering and on skids.

3.4 CLEANING

- A. Clean and repair existing materials and equipment, which remains or is to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangements.

END OF SECTION

Section 16050

Basic Electrical Materials and Methods

PART 1. GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. The electrical drawings and specifications under this section shall be made a part of the full contract documents. The drawings and technical specifications of this contract, supplemental information issued thereto, information to bidders and pertinent documents issued by the owner's representative are part of the overall construction documents. All constructions documents shall be complied with by general contractor
- D. The requirements herein are base requirements for all specifications. Other specifications will refer to this section for detailed requirements. No one specification will have all details. Specifications shall be reviewed as a complete package. Coordinate as needed
- E. All the above documents will be on file at the office of the owner's representative and shall be examined by all bidders prior to bid. Failure to examine all construction documents shall not relieve the responsibility of a fully functional system as described
- F. The documents shall not be used as a basis for additional compensation due to omission of details of other sections, specifications, documents, and drawings
- G. Furnish all work, labor, tools, staff, material, equipment, and operations necessary to provide and install a complete and functioning electrical system as defined in construction documents
- H. The contractor shall be responsible for visiting the project site prior to bid submission to verify existing conditions for relevant modifications to final bid
- I. It is the intent of the contract document that upon completion of the scope of work, the entire system shall be a finished/workable condition
- J. Secure all permits, licenses, easements, and inspections as required by all authorities having jurisdiction. Give all notices and comply with laws, ordinances, rules, regulations, and contract requirements
- K. Contractor shall determine the exact requirements for the utility service connections and metering facilities as set forth by the utilities that will serve the project. Contractor shall pay for and perform all work as required by those utilities. Refer to section 1.02 (A) for allowance requirements

- L. This specification section is an inherent part of all work performed on this project and its contents shall apply for any and all electrical, controls, instrumentation, and communication related work
- M. This specification covers all electrical equipment materials and methods required for a fully functional electrical system. This specification holds as a foundational document for electrical items stated in specifications under the same division
- N. Relocations and adjustments up to 50 feet are required per this contract as requested by owner or engineer at no additional cost to owner. Include cost in bid
- O. Contractor shall provide the equipment necessary for locating all underground pipes, conduits, and structures before digging. All locations of intersection shall be properly staked and identified. Locating all underground utilities is the sole responsibility of the contractor at no additional cost to owner
- P. Where obstructions are present in existing spare underground conduits to be used in this project, use video camera to determine cause of obstruction. Coordinate with engineer
- Q. Provide arc flash warning tags on all electrical equipment where required by NFPA 70E. Submit arc flash analysis for engineer's review
- R. Major scope of work:
 - 1. Provide and install fully operational lift station motor control center and control panel operating off primary pressure transducer with backup float relay system. MCC shall contain built in overcurrent protection system for electrical service and per pump, surge protection system, and emergency power quick connection transfer system with overcurrent protection. The pump system shall have permissive relays to prevent multiple HP lift pumps from operating simultaneously.
 - 2. Provide grounding system per NEC Article 250, construction drawings, and technical specifications
 - 3. Provide and install terminal boxes for pumps, float switches, and transducer
 - 4. Provide and install underground and above ground conduit/ductbank system as described in construction drawings and technical specifications
 - 5. Provide new electrical utility service for the new MCC. Coordinate all outages with utility and city. Contractor shall pay for all new service equipment as required via allowance.
 - 6. Coordinate outages and phasing as noted on drawings.
 - 7. Provide and install lighting and crane system equipment as noted on drawings.

8. Provide and install new electrical equipment for interconnection with existing natural gas generator.
 9. Provide and install alternate bid item for MCC room cable tray over base bid wall mounted conduit infrastructure.
 10. Provide and install new Primary Control System and SCADA System to operate lift station under primary transducer and interconnect data with city off site SCADA System operating off VT SCADA. Refer to plans and technical specifications for additional requirements. System shall include PLC, HMI, managed network switch, and cellular router.
- S. High level system requirements:
1. The electrical and control system shall include, but shall not be limited to, all circuit breakers, motor starters, motor control center, alternator, contactors, indicating lights, selector switches, surge protector, phase failure, heaters, instruments, relays, programmable controllers, alarm light, push buttons, control transformers, electronic devices, sensors, interlock wiring, nameplates, and all other associated items required
 2. Provide all heaters and equipment to motors per associated references and manufacturer's instructions

1.2 REFERENCES

- A. Installations shall conform to all appropriate articles/sections of latest standards, codes, local codes, and ordinances of the owner, authority having jurisdiction, and all entities involved. Contractor shall be responsible for verifying relevance of each reference requirement per the project scope, appropriateness, owner input, and historical requirements. Contractor may submit questions on code requirements where legitimate conflict exists. Relevant references may include all shown below:
1. National Electrical Code (NEC)
 2. Underwriters Laboratories (UL)
 3. National Electrical Manufacturers Association (NEMA)
 4. Insulated Power Cable Engineers Association (ICEA)
 5. International Building Code (IBC)
 6. National Fire Protection Association (NFPA) 70E – “Standards for safety in the workplace”
 7. American National Standard Institute (ANSI)
 8. Institute of Electrical and Electronic Engineers (IEEE)
 9. International Energy Conservation Code (IECC)
 10. Texas Center for Environmental Quality (TCEQ)
- B. Where contract documents indicate requirements, which are in excess of minimum requirements stated in section 1.03 (A), the most stringent

requirements shall be met. Should there be any conflicts between the contract documents and section 1.03 (A), submit RFI's prior to bid

- C. Codes and ordinances having jurisdiction and specified codes shall serve as minimum requirements. Where the Contract Documents indicate requirements which are in excess of those minimum requirements then the requirements of the Contract Documents shall be followed. Should there be any conflicts between the Contract Documents and codes, or any ordinances, report these with bid

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination

- 1. Contractor is bound to coordinate all equipment and scope of work with engineers and sub-contractors under this contract. Coordination of various equipment installations and operations is required as not to delay scheduled installation and startup
- 2. Refer to contractor responsibilities section of this document for further coordination items

B. Preinstallation meetings

- 3. Should contractor require a pre-installation meeting for any equipment with engineer, contractor shall provide ample time to schedule all required parties

C. Scheduling

- 4. Provide schedule of construction to engineer for review on a monthly basis. Refer to submittal section for further requirements

D. Change orders

- 5. Change orders and RFI's shall be submitted with full technical explanation of request and shall contain statement confirming contractor has reviewed all construction documents
- 6. Confirm all work has been coordinated with all other trades prior to submitting change order

1.4 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.5 RECORD DRAWINGS

- A. At the start and during the progress of the job, keep one separate set of blue-line prints for making construction notes and mark-ups
- B. Show conduit routing and wiring runs as constructed and identify each
- C. Record all deviations from the contract documents
- D. Submit set of marked-up drawings for review

1.6 QUALITY ASSURANCE

- A. All manufacturers named are a basis of design for standard and quality expected. Substitutions of any equal product will be considered for acceptance. The judgement of equality of product substitution shall be made by the engineer and owner
- B. UL Compliance: Materials manufactured within scope of Underwriters Laboratories shall conform to UL standards and have an applied UL listed mark
- C. Materials and equipment shall be new, free from defects. Any and all equipment deemed defective by engineer shall be replaced at no additional cost to owner
- D. All materials and equipment, of the same class, shall be supplied by the same manufacturer unless specified otherwise in construction documents
- E. Contractor shall consider all degrees of uncertainty for all existing, hidden or unknown conditions. Bid shall cover all reasonable unknown conditions not evident in pre-bid site visit for additions and modifications to existing facilities
- F. Any change orders or additional work beyond the scope of this project as bid shall be approved by engineer. Any unapproved work performed is at contractors' risk
- G. Installation shall conform to engineering drawings and described in specifications. Any variation shall be pre-approved in writing by engineer before work begins. Any unauthorized work may be requested for removal at contractors' expense with no delay to construction schedule and at no additional cost to owner
- H. Prior to bidding and during construction, contractor shall coordinate with equipment vendors/suppliers and determine requirements for power, control, and interconnection wiring. Provide conduits and conductors accordingly for complete operating system

1.7 PROJECT SAFETY:

- A. Electrical system for this project has lethal voltages present. Contractor shall have qualified personnel perform installations by, or under direct on-site supervision of, a licensed master electrician
- B. Contractor shall not work on energized equipment except when necessary and with all appropriate protective clothing, tools, and qualified staff required to perform tasks
- C. Submit "Job Safety Plan & Electrical Work Permit" per NFPA 70E to engineer
- D. Do not install fuel tanks within 50-feet of habitable building where prohibited by local codes. Field verify site with construction documents and notify engineer of any conflicts. Failure to do so is at contractors

1.8 CONTRACTOR QUALIFICATIONS

- A. All prequalification's under this contract shall be submitted prior to bid date
- B. All electrical work shall be performed by a Texas State Licensed Electrical Contractor
- C. Contractor and their subcontractors shall be experienced with electrical systems covered under this contract
- D. Contractor firm, project supervisors, and electrical labor workers without recent experience in similar projects shall not be utilized to perform work under this contract. Projects older than 5-years are not considered recent
- E. Electrical contractors, electricians, inspectors, installers, and programmers assigned to this project shall be full-time qualified employees
- F. Contract employees shall not be utilized unless approved by engineer
- G. Contractor shall be required to furnish proof of experience and employment where requested by owner, engineer, or their representatives
- H. Maintain safety training program throughout project timeline. Program may be requested for review by owner, engineer, or their representatives
- I. Pre-qualified electrical contractors are shown below:
 - 1. Alterman
 - 2. Clarion Electrical, LLC
 - 3. McDonald Electric
 - 4. Principal Control Services (PCS)
 - 5. Pfeiffer & Son, Ltd.
 - 6. RESCO Electric
 - 7. SECO
 - 8. Texan Municipal & Industrial
 - 9. W.W. Payton
 - 10. Or as pre-approved in writing via email, not less than seven (7) days before bid date

1.9 Contractor Responsibilities

- A. Contractor is bound to coordinate all equipment and scope of work with engineers and sub consultants under this contract. Coordination of various equipment installations and operations is required as not to delay scheduled installation and startup
- B. Any and all delegation of construction of sub-contractors shall be coordinated prior submittal review and meetings with owner, owners' representatives, and engineering team
- C. Scope of work in each specification and discipline drawings are ultimately

the sole responsibility of the general contractor under this contract

- D. Contractor shall verify all product materials and drawings prior to bidding
- E. Plans and diagrams are illustrative and may not contain all devices, wiring point-to-point diagrams, and controls required to perform the intended function in construction documents. Not all required equipment quantities required for a fully functional system may be documented in drawings or specifications. Location and alignments for equipment shown on plans may require adjustment. Contractor is responsible for providing all appurtenances required for each stand-alone system and overall project system
- F. Vendor furnished systems shall be coordinated prior to submittal to meet all required expectations in construction documents. All additional fees for testing, commissioning, and warranties shall be included in bid for all equipment/installation
- G. Contractor to provide full contact list of all sub-contractors and vendors under this contract to engineer upon notice to proceed. Contact information shall include: Person's name, title, direct telephone number, address, and email information
- H. All correspondence, RFI's, and submittals concerning electrical, controls, and related work shall be from general contractor. General contractor shall provide statement on all correspondence, RFI's, and submittals stating contractor has verified information and validity of the correspondence in reference to full construction documents from all disciplines. Any documents received not having this statement may be rejected without review
- I. Contractor shall reach out to engineer for coordination of construction methods, plans, and specifications should they deem beneficial
- J. Coordinate and pay all electrical power, natural gas, hardline telephone, cellular telephone, or special purpose utility installation. Contractor shall coordinate with owner for account setup or transfer ownership at substantial completion, method of choice is contractor's responsibility
- K. Maintain documentation and notify owner of all utility coordination and requirements for new/modified services

1.10 COORDINATION

- A. Coordinate installation of lightning protection with installation of other building systems and components including:
 - 1. Electrical wiring
 - 2. Supporting structures
 - 3. Building materials
 - 4. Metal bodies requiring bonding to lightning protection components

5. Building finishes

- B. Coordinate installation of air terminals attached to single-membrane roof system with roofing manufacturer and installer

1.11 SPARE PARTS

- A. Spare parts shall be hand delivered to operations team at 75% completion of project completion to operations team
- B. Furnish, tag, and box all spare parts in an organized manner. Provide detailed bill of materials of all items included in box
- C. Provide transmittal form documenting individuals delivering and receiving spare parts with date, signature, printed name, and title. Provide scanned copy to engineer for record keeping. Include documents in O&M manual
- D. Provide the following spare parts:

6. Fuses (0 – 600V): Six of each type and each current rating installed as part of this project unless otherwise specified

1.12 EMERGENCY POWER

- A. Where required by drawings, provide any and all provisions for continuous electrical service thru contractor furnished standby generator power. Contractor shall not utilize an existing standby generator on the facility unless given permission by owner and engineer. Include all provisions in bid
- B. Where power outage is required, coordinate with owner and engineer. Outage length shall be coordinated and approved by owner and engineer. Where outage exceeds approved timeframe, contractor shall provide equipment as required to maintain electrical power

1.13 PROGRAMMING RELATED ITEMS

- A. Contractor shall comply with programming allowances designated in bid sheet for this project to be paid to Guzman Engineering upon completion of shop test (50%) and substantial programming completion (100%)
- B. Refer to all sections of this specification and specifications from all disciplines for additional requirements under this contract
- C. General contractor and sub-contractors are not responsible for contents of program where Guzman Engineering perform the programming
- D. Warranty for operation of program is solely the responsibility of the programming firm, Guzman Engineering
- E. There are to be no contractual agreements between the contractor and/or his sub-contractors and the programming firm, Guzman Engineering
- F. Contractor is required to provide all software required for development and operation of Programmable Logic Controller (PLC) automation logic, Human Machine Interface (HMI), communication system, Distributed

Control Systems (DCS), Industrial Control System (ICS), Supervisory Control and Data Acquisition System (SCADA), network equipment, alarm system, and all other systems required for this project to programming firm, Guzman Engineering. Software shall remain unopened and include all relevant manuals

- G. Where modifications are performed on existing facilities where a new SCADA system is installed, route all existing alarms to auto dialer, alarm panel, and PLC. Install all conduit and wiring as required regardless if shown on construction drawings
- H. PLC program shall not be uploaded until an inspection by engineer has been performed. Any discrepancies to construction documents shall be corrected

PART II. PRODUCTS

2.1 GENERAL

- A. Products shown are not intended to discriminate against a product of similar quality and purpose by another manufacturer
- B. Provide coordination with manufacturer's representative for exact model, options, configurations, and services included in bid. Where construction documents do not match manufacturer's representative equipment list, contact engineer prior to ordering and installing
- C. Substitution items may be acceptable where deemed so by engineer and or owner's representative
- D. All equipment and materials shall be rated for harsh industrial environments.
- E. Equipment ratings shown on construction documents are minimum requirements and contractor may be required to provide the next size greater
- F. Door mounted rotating operating mechanisms for circuit breakers are not permitted
- G. All equipment installed on this project shall incorporate the installation of all devices and features to protect their respective equipment from the influence of other equipment, voltage irregularities, phase irregularities, power surges, harmonics, and other disturbances that may prevent proper and safe operation
- H. All equipment shall be NEMA rated, IEC components are prohibited
- I. Where model numbers are shown on drawings or specifications, provide current most up to date available model

PART II. EXECUTION

3.1 GENERAL

- A. Where required by drawings, provide any and all provisions for continuous

electrical service thru contractor furnished standby generator power. Contractor shall not utilize an existing standby generator on the facility unless given permission by owner and engineer. Include all provisions in bid

- B. Where power outage is required, coordinate with owner and engineer. Outage length shall be coordinated and approved by owner and engineer. Where outage exceeds approved timeframe, contractor shall provide equipment as required to maintain electrical power
- C. All construction and equipment fabrication shall be of highest quality and installed in a workmanlike manner

3.2 TESTING

- A. All equipment shall put through a trial run-in test to ascertain the performance complies with the intent of the specifications. All-in tests shall be made in the presence of the Engineer and owner's representatives. Control system shall be setup, calibrated, and tested by manufacturer's technician.
- B. Contractor shall startup entire system prior to engineer present inspections. All troubleshooting and issues shall be corrected prior to scheduling owner/engineer inspections
- C. All special testing of materials and equipment shall be provided by the contractor
- D. Contractor shall coordinate and schedule testing and startup work with the owner and engineer
- E. Provide full documentation for factor test and field tests
- F. Where facility is located more than 100 miles from the project site, supplier shall provide accommodations for overnight stay for engineering team
- G. All cables shall have an insulation test performed using 1000-volt megger that has been calibrated within the last twelve months
- H. Cables installed with an insulation reading less than 500 megohms shall be removed and new cable installed and retested at no additional cost to the owner.
- I. Cables installed with an unacceptable insulation reading shall be removed and new cable installed and retested at no additional cost to the owner. Submit cable megger test report to owner's representative and engineer for review. Include test results in O&M's.
- J. The grounding system shall be tested in the presence of the owner's representative using the fall of potential method and shall provide a grounding system resulting in an ohmic value of five (5) ohms or less at no additional cost to the owner. The contractor shall submit test report to owner's representative. Test equipment must be calibrated within the

previous 12 months. Provide dated calibration results along with submittal.

- K. All controls shall be fully tested prior to shipment and installation at project facility
- L. Contractor shall fully inspect all controls, wiring devices, conduit, and other items before starting work, ordering materials, or submitting shop drawings for discrepancies to construction documents. Inform engineer of any discrepancies. Failure to do so may result in contractor's responsibility for any required changes at no additional cost to owner

3.3 TRAINING

- A. Contractor shall provide two (2) 8-hour classes covering all equipment installed from a systematic level to general maintenance, operation, and troubleshooting. Provide all training manuals prior to start of class to operations, owner, and engineer for review
- B. Engineer or owner may attend training where requested
- C. Contractor shall provide adequate classroom environment or coordinate for on site facility to cover training
- D. Training agenda and outline of training course shall be forwarded to engineer for review
- E. Coordinate with any and all manufacturers required for adequate training
- F. Document all attendees and acquire signatures upon completion of training program
- G. Owner/Engineer shall sign a document provided by contractor indicating installation has formally been accepted
- H. Inform engineer where training does not require two (2) full 8-hour classes
- I. Schedule with owner minimum two (2) weeks in advance

3.4 INSTALLATION

- A. All slabs around electrical equipment shall be constructed and sloped to avoid any standing water
- B. Do not overfill raceways. Provide additional conduit where cables purchased exceed standard cable fill calculations
- C. Provide minimum 48 inches of workspace in front of electrical equipment
- D. Provide a minimum of 8 inches between wall or rack mounted enclosures/ equipment. Do not extend past building wall and maintain 6 inches from edge of wall

3.5 REPAIR/RESTORATION

- A. Where any equipment performance does not conform to specifications or parameters are out of tolerance, per engineers or owner's opinion, contractor shall remove and replace equipment at no additional cost to

owner

- B. Where contractor damages existing facilities, damaged equipment shall be replaced with equal or better at no additional cost to owner. Contractor shall take photos of facility prior to starting work to dispute any discrepancies. Where photos are not taken, damaged equipment shall be replaced at owner's request
- C. Any damage to underground utilities is the responsibility of the contractor for repair and restoration
- D. Where equipment fails or gets damaged, contractor shall replace with new. Repair is not permitted unless specifically approved by owner, owner's representative, or engineer

3.6 SYSTEM STARTUP

- A. Upon successful testing, contractor shall provide full system startup in presence of authority, owner's representative, and engineer presenting fully functional gate operating system with all respective capabilities.
- B. Contractor is responsible for coordinating with all parties required for system startup including manufacturer's prior to system startup. Ample time is required for coordination.
- C. System will be not be accepted by owner until all systems are started and presented to authority, owner's representative, and engineer without issues or pending punch list items.

3.7 ADJUSTEMENT/CALIBRATION

- A. Should initial testing or system startup not present an acceptable functioning system, adjustment/calibration shall be performed as necessary at no additional cost to owner.
- B. All equipment shall put through a trial run-in test to ascertain the performance complies with the intent of the specifications. All-in tests shall be made in the presence of the Engineer and owner's representative.

3.8 CLEANING

- A. Remove all temporary labels, dirt, paint, grease and stains from all exposed equipment. Upon completion of work, clean equipment and entire installation site in a workmanlike manner. No loose parts or scraps or equipment shall be left on the premises. Site shall not be accepted by owner where site is not suitably cleaned to engineer or owner's representative preference.
- B. Equipment paint scars shall be repaired with paint kits supplied by the equipment manufacturer, or with an approved paint.
- C. Clean interiors of each item of electrical equipment. At completion of work all equipment interiors shall be free from dust, dirt, and debris.
- D. Concrete spoils shall not be dumped on site without approval by engineer

or owner

3.9 CLOSEOUT

- A. System acceptance upon substantial completion shall occur only when the below items have been submitted, accepted, and approved.
 - 1. Submittals
 - 2. O&M Manuals
 - 3. Contractor testing
 - 4. Inspections
 - 5. Operations team training
 - 6. Warranty certificates
 - 7. Shop testing
 - 8. Record drawings
 - 9. Spare parts

3.10 MAINTENANCE/WARRANTY

- A. Provide extended warranty certificates with contact information to operations and include in Operations & Maintenance manual.
- B. Contractor shall provide full system wide warranty on all equipment for 3-year. Warranty shall include all labor and materials required to repair or replace equipment defective or malfunctioning at no additional cost to owner
- C. Provide any and all testing equipment required to verify equipment malfunction (i.e. power monitor, etc.)
- D. Warranty shall include, but not limited to; equipment, devices, hardware, and software
- E. Warranty begins at time of written acceptance of substantial completion
- F. Provide warranty certificates for electrical installation and consolidate warranty certificates from sub consultants with contact information for repairs
- G. General contractor is ultimately responsible for all warranty items and requests
- H. All repairs shall be made within 24 hours of receipt of required parts from manufacturer with minimum priority shipping. Any repairs not completed within five (5) working days from date of notice are subject to owner hiring separate integrator to perform services. Services shall be invoiced to general contractor

END OF SECTION

Section 16051

Basic Electrical Submittal and O&M Requirements

PART 1. GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Requirements described in this specification are in addition to any submittal requirements of other specifications

1.2 SUBMITTALS

- A. Submit all submittals within sixty (60) days of notice to proceed.
- B. Review of submittals shall not remove sole responsibility of contractor for furnishing materials or equipment of proper dimension, quantity, quality, or rating; nor will such review remove the responsibility for errors in the submittals.
- C. Each submittal shall be submitted as a single pdf per specification with all related equipment.
- D. Include catalog cuts, general descriptive information, catalog numbers, and manufactures name
- E. Shop drawings shall include detailed drawings with dimensions, schedules, weights, capacities, installation details, and all pertinent information for a complete and fully functional equipment installation.
- F. Failure to process submittals on any item(s) specified shall be at risk of contractor to replace any and all unreviewed items as directed by engineer, authority, or owner.
- G. Contractor shall assume all costs and liabilities which may result ordering and installing any equipment/material prior to review of the submittals. No work shall be done prior to review of all submittals. In case of corrections required, rejection and resubmit required; resubmit submittals until owner's representative and or engineer review updated submittals. This process shall not label as cause of any delays in construction.
- H. Contractor shall have two (2) submittal reviews after which contract may be charged by owner and or engineer at firm hourly rates to review additional submittals. After final reviews, provide final copies in printed/PDF O&M Manuals.
- I. Submittals shall be compiled from the manufacturer's latest product data. Provide most update product where product specified has been replaced, recalled, discontinued, or newer product exists. Provide description on submittal stating reason for not providing product specified in construction documents.

- J. Contractor shall clearly indicate on submittal which items and options are proposed. Submittal may be marked rejected-resubmit where if specific items and options proposed are not clearly marked. Submittal may be rejected where transmittal cover page and required information in this section is not provided.
- K. Where requested, furnish samples of materials for acceptance review. If a sample has been reviewed and accepted, equipment installed shall maintain equal quality to sample provided. Should engineer deem installed equipment does not match quality of sample provided, item shall be replaced at engineer's discretion at no additional cost to owner
- L. Submittals shall be provided one section at a time. All related submittals are to be provided at one time
- M. Hard copies are not required for submittal review. Where required by owner, or general conditions, hard copies of any and all documentation shall be under the contractor's responsibilities
- N. Provide a schedule describing estimated start dates, completion dates, shop test dates, and field test dates. Contractor shall provide updated schedules to our office in a regular schedule upon any changes
- O. Contractor shall provide submittal log showing status of submittal approved, rejected, and pending with each submittal
- P. Contractor shall review all voltages, horsepower, current, phase, and starter size requirements for all equipment prior to providing submittals to engineer for review. Shop drawing review by engineer does not remove this responsibility. Incorrect submittal information shall be at risk of contractor and at no additional cost to owner
- Q. Data sheets shall have model numbers that correctly identify equipment and accessories as described in construction documents highlighted or boxed
- R. Submittals shall require a minimum of two (2) weeks for review from time of receipt by engineer. Contractor shall provide submittals with sufficient time for review as to no impede construction schedule. Lack of required coordination shall not be acceptable for construction schedule extension
- S. All submittals for control panels, control sections of MCC, controllers, and vendor furnished panels shall contain statement of U.L. certification and identifying name and number of U.L. certification for fabrication shop. All submittals without this information shall be marked rejected. Any panels installed without U.L. listing, and where not acceptable by engineer or owner, shall be replaced at no additional cost to owner
- T. Any and all equipment installed without approval not matching construction documents shall be replaced at no additional cost to owner
- U. General contractor shall route all vendor submittals with electrical requirements to electrical contractor who shall review and coordinate all

power and control items. Any variation to construction documents shall be noted accordingly on submittal

- V. All resubmittals shall indicate modifications due to original submittal comments from engineer
- W. Include all relevant technical specifications with each submittal. Mark each section as “comply”, “non-compliant”, and “substitution”
- X. Provide transmittal cover page on all submittals with the following information:
 - 1. General contractor company name
 - 2. General contractor project manager name and contact information
 - 3. Sub-contractor company name
 - 4. Sub-contractor project manager name and contact information

1.3 ACCEPTANCE AND SUBSTITUTIONS

- A. All manufacturers named are a basis as a standard of quality and substitutions of any equal product will be considered for acceptance. The judgment of equality of product substitution shall be made by the Engineer and owner’s representative
- B. Substitutions for equipment specified or shown on plans as “Or pre-approved equal” shall be submitted for approval prior to bid. Failure to submit RFI for pre-approval may lead to rejection of substitution for higher cost equipment originally specified in construction documents.
- C. Substitutions after award of contract shall be made only within sixty (60) days after notice to proceed. Furnish all required supporting data. The submittal of substitutions for review shall not be cause for time delay of construction.
- D. Where substitutions are offered, the substituted product shall meet the product performance as set forth in the specified manufacturer’s current catalog literature, as well as meeting the details of the construction documents.
- E. The details on the drawings and the requirements of the specifications are based on the first listed item of material or equipment; if any other than the first listed materials or equipment is furnished, then assume responsibility for the correct function, operation, and accommodation of the substituted item. In the event of misfits or changes in work required, either in this Section or other Sections of the Contract, or in both; bear all costs in connection with all changes arising out of the use of other than the first listed item specified

1.4 REQUIRED SUBMITTALS FOR REVIEW:

- 1. Power quality monitors
- 2. Wiring devices

3. Wire
4. Conduit and fittings
5. Automatic transfer switch
6. SCADA system
7. Main service disconnect/circuit breaker
8. Enclosed circuit breakers
9. Motor control center
10. Low voltage transformer
11. Surge protection devices
12. Wet well j-box
13. All relays & terminals
14. Grounding
15. Junction boxes and pull boxes
16. Terminal junction boxes
17. Panelboards and circuit breaker data
18. Fuses
19. Contactors
20. Cable Tray
21. Transformers
22. Control cabinet enclosures
23. Control cabinet wiring and terminal blocks
24. Control cabinet devices and nameplates
25. Control panels
26. Vendor furnished equipment
27. Project schedule on a monthly basis
28. Warranty certificates
29. Testing reports

1.5 OPERATIONS & MAINTENANCE MANUALS

- A. Hardcopies provided to owner, once approved, are to be professionally assembled with tabs and coversheets
 1. Wiring diagrams shall be on same size pages (8.5 x 11 or 11 x 17 pullout sheets) as used in O&M's and shall be placed in a separate section of the manuals identified "Wiring Diagrams"
 - a. Each O&M manual hard copy shall include USB jump drive

- containing complete and organized in PDF format inserted in pocket of binder
 - b. All O&M manuals shall be written in a professional manner and bound in high quality latching vinyl binder. Loose page three ring binders shall not be used for hard copy O&M manual
 - B. Provide diagrams of all control panels in clear plastic laminated pages. One (1) hard copy and one (1) copy in pocket affixed to inside of cabinet door
 - C. Six (6) weeks prior to the completion of the project, compile an operations and maintenance manual for each item of equipment. These manuals shall include detailed instructions and maintenance, warranty certificates, vendor contact information, and spare parts lists
 - D. O&M manuals shall be reviewed by engineer and owner's representative prior to printing and delivering hard copy to operations
 - E. In addition to record drawings, submittals, manufacturer's operational instructions, and maintenance instructions, O&M's shall include sufficient literature to detail operation, removal, installation, configuration, adjustment, calibration, and testing of equipment by operations
 - F. All related submittals are to be provided at one time as follows:
 - 1. Contact information for all contractors and vendors
 - 2. System hardware/installation
 - 3. System software (where applicable)
 - 4. Operation of equipment
 - 5. Electrical and Control wiring diagrams
 - 6. Maintenance and Troubleshooting
 - 7. Warranty Certificates
 - 8. Point-To-Point wiring diagrams for each circuit installed
 - G. O&M manuals should be complete and approved prior to any scheduled training
- 1.6 RECORD DRAWINGS**
- A. At the start and during the progress of the job, keep one separate set of blue line prints for making construction notes and mark-ups
 - B. Show conduit routing and wiring runs as constructed and identify each. Record all deviations from the Contract Documents
 - C. Submit set of marked up drawings for review
 - D. The Contractor is always required to keep up to date blue lines and may be reviewed during construction at any time by the Engineer. Record Drawings that are found to be inaccurate are the responsibility of the Contractor
 - E. Provide Record Drawing that clearly show any work that varies from the

Contract Drawings. Remove any lines or text from drawings that no longer apply as a result of as installed variations. "Record Drawing" Drawings shall be on backgrounds that are furnished by the Engineer. Submit Record Drawing Drawings electronically for review

- F. Show accurate dimensioned layout of conduits under or encased in building slabs
- G. Show accurate dimensioned location of all conduits and ductbanks on site and on structures that are installed or modified under this contract. Identify conduits by tag number
- H. Record Drawing construction drawings shall be provided on full size plan sheets for Owner and furnished electronically in AutoCAD format for Owner and Electrical Engineers files. Provide hard copy quantities specified in this specification or in General Conditions Specifications, whichever is more stringent

END OF SECTION

Section 16052 Electrical Identification

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. Identification of electrical materials, equipment, and installations
- D. Nameplate identification on MCC's and control panels
- E. Arc Flash Warning Signs
- F. Equipment and High Voltage Warning Signs
- G. Identification of conduit and conductors

1.2 REFERENCES

- A. National Electrical Code: Components and installation shall comply with NFPA 70
- B. Comply with ANSI C2

1.3 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.4 RECORD DRAWINGS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.5 OPERATIONS & MAINTENANCE MANUALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

PART II: PRODCUTS

2.1 RACEWAY AND CABLE LABELS

- A. Label wiring with yellow heat shrink type markers with black machine printing. Labels shall be Raychem or Panduit
- B. Buried conduit marking tape for marking path of buried conduits shall be a six (6") inch and red color nominal width strip of polyethylene with highly visible and foil backed, repetitive marking "BURIED CONDUIT", or similar language, along its length
- C. Nameplates shall be micarta lamicoid material, 1/8" thick, black background with white 3/8 IN. block lettering engraving. Attachment means shall be made with a minimum of two aluminum rivets. All instruments shall have round shaped black phenolic tags with white 1/4 IN. block lettering, attach

with 316 SS cable

- D. Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere
- E. Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size
 - 1. Color: Black legend on orange field
 - 2. Legend: Indicates voltage
- F. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color coded, acrylic bands sized to suit diameter of line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position
 - 1. Provide identification wire marker for all power and control conductors.
- G. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 in. wide for phase and ground conductor identification
- H. Underground Line Warning Tape: Permanent, bright colored, continuous printed, vinyl tape with following features:
 - 1. Size: Not less than 6 in. wide by 4 mils thick.
 - 2. Compounded for permanent direct burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed Legend: Indicates type of underground line.
- I. Tape Markers: Vinyl or vinyl cloth, self-adhesive, wraparound type with preprinted numbers and letters. Limited use for indoor control cabinets
- J. Aluminum, Wraparound Marker Bands: Bands cut from 0.014 in. (0.4 mm) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors
- K. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field printed legends. Orange background, except as otherwise indicated, with eyelet for fastener
- L. Aluminum Faced Card Stock Tags: Wear resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 in. (0.05 mm) thick, laminated with moisture resistant acrylic adhesive, and punched for fastener. Preprinted legends suit each application
- M. Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener. Dimensions: 2 by 2 in. by 0.05 in. for conduit and power conductor identification. Attached with stainless steel bands

2.2 ENGRAVED NAMEPLATES AND SIGNS

- A. Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere
- B. Engraving stock, melamine plastic laminate, 1/16 in. (1.6 mm) minimum thick for signs up to 20 sq. in. (129 sq. cm), 1/8 in. (3.2 mm) thick for larger sizes.
 - 1. Engraved Legend: Black letters on white face.
 - 2. Punched for mechanical fasteners or stainless-steel screws.
 - 3. Use in control panels, MCC's, device housings, boxes, and similar locations.
- C. Baked Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for application. 1/4 in. (6.4 mm) grommets in corners for mounting
- D. Exterior, Metal Backed, Butyrate Signs: Wear resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396 in. (1 mm), galvanized steel backing, with colors, legend, and size appropriate to application. 1/4 in. (6.4 mm) grommets in corners for mounting
- E. Fasteners for Plastic Laminated and Metal Signs: Self-tapping stainless-steel screws or No. 10/32 stainless steel machine screws with nuts, flat washers and lock washers
- F. Exterior, Painted Aluminum, Warning Signs: Wear resistant, non-fading, pre-printed aluminum with glossy finish with colors, and size appropriate to applications, 1/4 inch grommets in corners for mounting. Provide per standards ANSI 2535 and OSHA 1910.145

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungusinert, self-extinguishing, 1 piece, self-locking, Type 6/6 nylon cable ties with following features:
 - 1. Minimum Width: 3/16 inch
 - 2. Tensile Strength: 50-pound minimum.
 - 3. Temperature Range: -40°F to 185°F
 - 4. Color: As indicated where used for color coding
- B. Paint: Alkyd-urethane enamel. Primer as recommended by enamel manufacturer

2.4 MCC AND CONTROL PANELS

- A. Wire Markers: Provide wire markers on all power and wiring in MCC's and panels of all types. Identify wire at points of termination at devices and at terminal strips

- B. Provide nameplates on body or housing of all pressure switches, transmitters, and other devices
- C. Provide engraved nameplates near base of all relays and similar devices. Adhesive materials not allowed

PART III: EXECUTION

3.1 Installation

- A. Disconnecting Means/Circuit Breakers
 - 1. All disconnecting means shall include the identification of the circuit source that supplies the disconnecting means and be legibly marked, with durable label, to indicate its purpose.
- B. Install identification devices according to manufacturer's written instructions.
- C. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment
- D. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and or designations used for electrical identification with corresponding designations used in Contract Documents or required by codes and standards. Use consistent designations throughout Project
- E. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work
- F. Self-Adhesive Identification Products: Not allowed. Use stainless steel screws.
- G. Identify feeders over 600 V with "DANGER HIGH VOLTAGE"; in black letters 2 in. (51 mm) high, stenciled with paint at 10 ft (3 m) intervals over continuous, painted orange background. Identify following:
 - 1. Entire floor area directly above conduits running beneath and within 12 in. (305 mm) of basement or ground floor that is in contact with earth or is framed above un-excavated space
 - 2. Wall surfaces directly external to conduits concealed within wall
 - 3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in building, or concealed above suspended ceilings
 - 4. Entire surface of exposed conduits
- H. Install painted identification as follows:
 - 1. Clean surfaces of dust, loose material, and oily films before painting
 - 2. Prime Surfaces: For galvanized metal, use single component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy duty, acrylic resin block filler. For concrete surfaces, use clear, alkali resistant, alkyd binder type sealer
 - 3. Apply one intermediate and one finish coat of silicone alkyd enamel

4. Apply primer and finish materials according to manufacturer's instructions
- I. Identify Raceways and Exposed Cables of Certain Systems with Color Banding: Band exposed and accessible raceways of systems listed below for identification
 1. Bands: Pre-tensioned, snap around, colored plastic sleeves; colored adhesive tape; or combination of both. Make each color band 2 in. (51 mm) wide, completely encircling conduit, and place adjacent bands of 2 color markings in contact, side by side
 2. Locate bands at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft (7.6 m) in congested areas
 3. Colors: As follows:
 - a. Fire Alarm System: Red
 - b. Fire Suppression Supervisory and Control System: Red and yellow
 - c. Combined Fire Alarm and Security System: Red and blue
 - d. Security System: Blue and yellow
 - e. Mechanical and Electrical Supervisory System: Green and blue
 - f. Telecommunications System: Green and yellow
- J. Install Caution Signs for Enclosures: Use label indicating system voltage in black, preprinted on orange field. Install on exterior of door or cover with stainless screws
- K. Install Circuit Identification Labels on Boxes: Label externally as follows:
 1. Exposed Boxes: Plastic label on cover
 2. Concealed Boxes: Plasticized card stock tags
 3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent
- L. Identify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground plastic line marker located directly above line at 6 to 8 in. (150 to 200 mm) below finished grade. Where multiple lines installed in common trench or concrete envelope do not exceed an overall width of 16 in. (400 mm), use single line marker
 1. Install line marker for underground wiring, both direct buried and in raceway
- M. Color Code Conductors: Secondary service, feeder, and branch circuit conductors throughout secondary electrical system
 1. Field applied; color coding methods may be used in lieu of factory coded wire for sizes larger than No. 10 AWG

- a. Colored, pressure sensitive plastic tape in half lapped turns for distance of 6 in. (150 mm) from terminal points and in boxes where splices or taps are made. Apply last 2 turns of tape with no tension to prevent possible unwinding. Use 1 in. (25 mm) wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings
- b. Colored cable ties applied in groups of three (3) ties of specified color to each wire at each terminal or splice point starting 3 in. (76 mm) from terminal and spaced 3 in. (76 mm) apart. Apply with special tool or pliers, tighten to snug fit, and cut off excess length

System Voltage	A	B	C	Neutral
120/240 Volt 1Ph/3w	Black	Red		White
120/208 Volt 3Ph/4w	Black	Red	Blue	White
120/240 Volt 3Ph/4w	Black	Orange	Blue	White
277/480 Volt 3Ph/4w Grey	Brown		Purple	Yellow
Motor Control	1	Black		
	2	Red		
	3	Blue		
	Ground	Green		

- N. Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms
 1. Legend: 1/4 in. (6.4 mm) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations
 2. Fasten tags with nylon cable ties; fasten bands using integral ears
- O. Conduit Identification: Use aluminum tags with SS bands at termination points such as MCC, light fixtures, control panels, receptacles and junction boxes. Tag is to include conduit tag and panel circuit number (where applicable.)
- P. Apply identification to conductors as follows:
 1. Conductors to Be Extended in Future: Indicate source and circuit numbers.
 2. Multiple Power or Lighting Circuits in Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit
 3. Multiple Control and Communications Circuits in Same Enclosure: Identify each conductor by its system and circuit designation. Use consistent system of tags, color coding, or cable marking tape

- Q. Apply warning, caution, and instruction signs and stencils as follows:
1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items
 2. Install warning signs on the following equipment as a minimum requirement
 - a. MCC Main Breaker
 - b. Main Service Breaker
 - c. Transfer Switch
 - d. Where exposed bus bars inside.
 - e. Automatic Power Factor Correction Units
 - f. VFD's and Solid-state Starters
 - g. Other locations described in No. 1 above.
 3. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch-high lettering for emergency instructions on power transfer, load shedding, and/or emergency operations
- R. Install identification as follows:
1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal control, and alarm systems, unless units are specified with their own self-explanatory identification
 2. Except as otherwise indicated, provide single line of text with ½ inch high lettering on 1 ½ inch high label; where two (2) lines of text are required, use ½ inch lettering on 2-inch-high label. For small control panels a smaller text may be used but shall be clearly readable. Use black lettering on white field. Use red lettering on white field where shown on plans or as requested by Engineer or Owner. Apply labels with stainless screws for each unit of following categories of equipment.
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items
 - c. Electrical switchgear and switchboards
 - d. Electrical substations
 - e. Motor control centers and control panels
 - f. Motor starters
 - g. Push button stations
 - h. Power transfer equipment

- i. Contactors
 - j. Remote controlled switches
 - k. Dimmers
 - l. Control devices
 - m. Transformers
 - n. Inverters
 - o. Rectifiers
 - p. Frequency converters
 - q. Battery racks
 - r. Power generating units
 - s. Telephone equipment
 - t. Conduits at manholes, at junction boxes, and pull boxes
- 3. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker
 - 4. For control panels the nameplate designation shall be according to the control, alarm or status function indicated on the control diagrams, one-line diagrams, details as required in other applicable specifications for this project
 - 5. Provide nameplate designations list and nameplate and text size for Engineer and/or Owner's approval as required by 1.02 of this specification
- S. Labeling
- 1. In addition to requirements for labeling as specified throughout this section, install as follows:
 - a. Phase color insulation is required for all conductors, no exceptions
 - b. Apply numbered wire marking labels to control wires; power wiring in panelboards, pull and junction boxes, and at outlets to identify circuit numbers. Each control wire shall be labeled at each connection. Labels shall heat shrink type
 - c. Apply Phenolic labels with engraved identification to wiring sets in each hand-hole to identify function. Use waterproof labels
 - d. Apply write-on identification labels to empty conduits to identify each with information as to terminus of other end and also trade size of conduit.
 - e. Install micarta nameplates with engraving to identify function and/or load served for the following:
 - i. Panelboards

- ii. Overcurrent Devices
 - iii. Power Quality Monitor
 - iv. Control Panels
 - v. Automatic Transfer Switch
 - vi. Wet Well Junction Box
 - vii. All components in control panel and SCADA panel
 - f. Micarta nameplates shall be attached with aluminum rivets, use two (2) per each nameplate
 - g. Submit for review a schedule for engraving along with size for each proposed micarta nameplate. Do not fabricate nameplate until review has been completed
 - h. Type circuit directory information on circuit directory cards on all panelboards and laminate
- T. Wiring
- 1. Heat shrink type labels shall be installed to identify circuit numbers from panel boards. Install labels on each wire in each panelboard, junction, and pullbox, and device connection
 - 2. Label each wiring run with heat shrink type labels inside each motor control center and in-service switchboard. Install write-on label ties around wire group at conduit entrance and write-on label the wire size, and service
 - 3. Install numbered marking on each control wiring termination at each terminal strip and at each device. Do this in motor control center, terminal cabinets, safety switches, remote controllers, pilot operators, and instrumentation equipment. Number selected shall correspond to number on terminal strip

END OF SECTION

Section 16060 Grounding and Bonding

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only.
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. B3 - Standard Specification for Soft or Annealed Copper Wire
 - 2. B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - 3. B33 - Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
 - 4. E699 - Standard Criteria for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating Building Components
- B. National Fire Protection Association (NFPA): NFPA 780 – Standard for the Installation of Lightning Protection Systems
- C. Underwriter's Laboratories (UL): 467 UL Standard for Safety Grounding and Bonding Equipment

1.3 SUBMITTALS, RECORD DRAWINGS, AND O&M MANUALS

- D. Refer to specification for Basic Submittal and O&M Requirements 16051
- E. Test Results: Report of field tests and observations certified by contractor

PART II: PRODUCTS

2.1 GROUDNING DEVICES

- A. Exothermally welded joints shall be made with Enrico "cadweld"
- B. Ground bus connectors shall be Square D type "LU", OZ Type "XLH", or equal
- C. Products: Of types indicated and of sizes and ratings to comply with current NEC. Where types, sizes, ratings, and quantities indicated are in excess of current NEC requirements, more stringent requirements and greater size, rating, and quantity indications govern
- D. Conductor Materials: Copper

2.2 WIRE AND CABLE CONDUCTORS

- A. Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding
- B. Equipment Grounding Conductor: Green insulated
- C. Grounding Electrode Conductor: Stranded cable
- D. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3
 - 2. Assembly of Stranded Conductors: ASTM B8
 - 3. Tinned Conductors: ASTM B33

2.3 MISCELLANEOUS CONDUCTORS

- A. Ground Bus: Bare annealed copper bars of rectangular cross section
- B. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules
- C. Bonding Strap Conductor/Connectors: Soft copper, 0.05-inch-thick and 2 inch wide, except as indicated

2.4 CONNECTOR PRODUCTS

- A. General: Listed and labeled as grounding connectors for materials used.
- B. Pressure Connectors: High conductivity plated units
- C. Bolted Clamps: Heavy duty units listed for application
- D. Exothermic Welded Connections: Provide in kit form and select for specific types, sizes, and combinations of conductors and other items to be connected

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper clad steel with high strength steel core and electrolytic grade copper outer sheath, molten welded to core
 - 1. Size: 3/4 inch by 10 feet unless otherwise indicated.
- B. Plate Electrodes: Copper plates, minimum 0.10 in. thick, size as indicated.

PART III: EXECUTION

3.1 PREPERATION

- A. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated
 - 1. Install separate insulated equipment grounding conductors with circuit

conductors

- a. Raceway may be used as equipment ground conductor where feasible in non-hazardous areas and permitted by current NEC for lighting circuits and receptacle circuits
 - b. Install insulated equipment ground conductor in nonmetallic raceways unless designated for telephone or data cables
- B. Underground Conductors: Bare, tinned, stranded copper except as otherwise indicated
- C. Signal and Communications: For telephone, alarm, instrumentation and communication systems, provide #4 AWG minimum green insulated copper conductor in raceway from grounding electrode system to each terminal cabinet or central equipment location
- D. Ground separately derived systems required by NEC to be grounded in accordance with NEC Paragraph 25030.
- E. Metal Poles Supporting Outdoor Lighting Fixtures: Ground pole to grounding electrode as indicated in addition to separate equipment grounding conductor run with supply branch circuit
- F. Connections to Lightning Protection System: Bond grounding conductors or grounding conductor conduits to lightning protection down conductors or grounding conductors in compliance with NFPA 780
- G. Common Ground Bonding with Lightning Protection System:
 1. Bond electric power system ground directly to lightning protection system grounding conductor at closest point to electric service grounding electrode, using exothermic welded connection
 2. Use bonding conductor sized same as system ground conductor and installed in conduit
- H. At all water, wastewater and industrial facilities, install UFER grounding per Item 3.02 – “Installation” at all equipment structures and buildings unless specifically deleted
- I. Bond all metallic fences, gates, posts, steel structural columns, and other exposed steel structures
- J. Install ground rod at all outdoor control panel, service rack, equipment racks, radio tower, steel canopy structures, and other steel structures where electrical equipment is installed

3.2 INSTALLATION

- A. Each item of equipment shall be adequately and thoroughly grounded. Comply with Article 250 of N.E.C., except where higher standards of grounding have been specified
- B. Equipment grounding conductors (EGC) shall be installed where indicated. These wires shall be green colored for all sizes

- C. EGC runs into equipment and shall be grounded to equipment bus where available, or to equipment ground lugs
- D. Where grounding type myers hub are installed, bond EGC thereto and furthermore ground each myers hub lug to equipment ground bus or ground lug, or ground rod
- E. In each motor terminal box, install equipment ground lug and connect EGC thereto
- F. In each floodlight pole, install ground connector to pole and bond to conduit bushing and to EGC in branch circuit
- G. Install grounding conductor in all raceways and ground at both ends
- H. General: Ground electrical systems and equipment in accordance with current NEC requirements except where Drawings or Specifications exceed NEC requirements
- I. Ground Rods:
 - 1. Locate minimum of one rod length from each other and at least same distance from any other grounding electrode
 - 2. Interconnect ground rods with bare conductors buried at least 24 in. below grade
 - 3. Connect bare cable ground conductors to ground rods by means of exothermic welds
 - 4. Make connections without damaging copper coating or exposing steel
 - 5. Use 3/4 inch by 10 ft. ground rods except as otherwise indicated.
 - 6. Drive rods until tops are 6 inches below finished floor or final grade except as otherwise indicated
- J. Metallic Water Service Pipe:
 - 1. Provide insulated copper ground conductors, sized as indicated, in conduit from building main service equipment, or ground bus, to main metallic water service entrances to building
 - 2. Connect ground conductors to street side of main metallic water service pipes by means of ground clamps
 - 3. Bond ground conductor conduit to conductor at each end
- K. Braided Type Bonding Jumpers: Use elsewhere for flexible bonding and grounding connections
- L. Route grounding conductors along shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated
- M. Test Wells: Locate as indicated, and fabricate in accordance with details indicated

N. UFER Ground:

1. Fabricate with 20 feet of bare 2/0 (minimum) copper conductor laid lengthwise in excavation for foundation or footings
2. Install so conductor is within 2 in. of bottom of concrete
3. Where base of foundation is less than 20 feet in length, coil excess conductor at base of foundation
4. Bond conductor to reinforcing steel at four locations, minimum. Bond to all electrical equipment
5. Extend conductor below grade and connect to building grounding grid or grounding electrode
6. Extend to all steel support columns for buildings, equipment structures or roof columns
7. Alternate UFER Grounding: Install 2/0 (minimum) bare copper conductor in 24" deep trench around perimeter of structures, buildings, slabs, and foundations where electrical or mechanical equipment is located. Install 4 ft. from edge of structure. Bond to all steel structure and equipment and to grounding system, using exothermic welded connections
8. Do not install ground grid conductors in or under existing concrete adjacent to generators electrical equipment without written approval from Engineer

3.3 CONNECTIONS

- A. General: Make connections to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible
1. Use electroplated or hot tin coated materials to assure high conductivity and make contact points closer in order of galvanic series
 2. Make connections with clean bare metal at points of contact
 3. Aluminum to steel connections: stainless steel separators and mechanical clamps
 4. Aluminum to galvanized steel connections: tinplated copper jumpers and mechanical clamps
 5. Coat and seal connections involving dissimilar metals with inert material such as red paint to prevent future penetration of moisture to contact surfaces
- B. Exothermic Welded Connections:
1. Use for connections to structural steel, water tanks, equipment, generators and enclosures, and for underground connections

2. Install at connections to ground rods and plate electrodes.
 3. Comply with manufacturer's written recommendations. Use CAD-Weld or approved equal
 4. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable
- C. Terminations:
1. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure type grounding lugs
 2. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to housing, terminate each conduit with grounding bushing
 3. Connect grounding bushings with bare grounding conductor to ground bus in housing
 4. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors
- D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torqueing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A-486B
- E. Connections at Test Wells: Refer to details for connections between conductors and ground rods
- F. Compression Type Connections: Where compression type connections are specifically called for on plans, use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make visible indication that connector has been adequately compressed on ground conductor
- G. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate entire area of connection and seal against moisture penetration of insulation and cable

3.4 OVERHEAD LINE GROUNDING

- A. General: Comply with ANSI C2, "National Electrical Safety Code"; for "Single Grounded Systems"; using two electrodes in parallel if single electrode resistance to ground exceeds 25 ohms
- B. Ground Rod Connections: Use exothermic welds for underground connections and connections to rods.
- C. Lightning Arresters: Separate arrester grounds from other ground conductors.
- D. Secondary Neutral and Tank of Transformer: Interconnect and connect to

ground.

- E. Grounding Conductor Protection: Protect grounding conductors running on surface of wood poles with molding of a type manufactured for this purpose. Extend from grade level up to and through communications and transformer spaces

3.5 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Manholes and Handholes:

1. Install 3/4inch by 10ft. driven ground rod in corner close to wall and set rod depth such that 4 inches will extend above finished floor
2. Where necessary, install ground rod before manhole is placed and provide No. 1/0 bare tinned copper conductor from ground rod into manhole through waterproof sleeve in manhole wall
3. Protect ground rods passing through concrete floor with double wrapping of pressure sensitive tape or heat shrunk insulating sleeve from 2 in. above to 6 in. below concrete
4. Seal floor opening with waterproof non-shrink grout.

B. Connections at Manholes:

1. Connect exposed metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole to ground rod or ground conductor
2. Make connections with minimum No. 4 AWG stranded hard drawn copper wire
3. Train conductors' plumb or level around corners and fasten to manhole walls.
4. Connect to cable armor and cable shields by means of tinned terminals soldered to armor or shield, or as recommended by manufacturer of splicing and termination kits

- C. Grounding System: Ground noncurrent carrying metallic items associated with manholes, substations, and pad mounted equipment by connecting them to bare underground cable and grounding electrodes arranged as indicated.

3.6 SITE QUALITY CONTROL

A. Test:

1. Subject completed grounding system to megger test at each location where maximum ground resistance level is specified, at service disconnect enclosure ground terminal, and at ground test wells
2. Measure ground resistance without soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural

ground resistance

3. Perform tests by 2point method in accordance with Section 9.03 of IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System"
- B. Ground/resistance maximum values shall be as follows:
 1. Equipment rated 500 kVA and less: 10 Ohms.
 2. Equipment rated 500 kVA to 1000 kVA: 5 Ohms.
 3. Equipment rated over 1000 kVA: 3 Ohms.
 4. Unfenced substations and pad mounted equipment: 5 Ohms.
 5. Manhole grounds: 10 Ohms.
- C. Deficiencies: Where ground resistances exceed specified values, notify Engineer, and if directed by Engineer, modify grounding system to reduce resistance values. Where measures are directed that exceed those indicated, provisions of Contract covering changes will apply
- D. Report: Prepare test reports, certified by testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results

3.7 RESTORATION

- A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated
- B. Where sod has been removed, replace it as soon as possible after backfilling is completed
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition
- D. Include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, or mulching
- E. Restore disturbed paving as indicated

END OF SECTION

Section 16121 Low-Voltage Conductors and Cables

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid

1.2 REFERENCES

- A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA 70 - National Electrical Code (NEC):
 - 1. Article 310 - Conductors for General Wiring
 - 2. Article 200 – Use and Identification of Grounded Conductors
- B. EPA, 40CFR, Part 261.24 Toxicity Characteristic
- C. CSA FT-4 Vertical Cable Tray Flame Tests
- D. Underwriter's Laboratories (UL)
 - 1. UL 44: Rubber Insulated Wires and Cables
 - 2. UL 83: Thermoplastic Insulated Wires and Cables
 - 3. UL 514 B: UL Standard for Safety Conduit, Tubing, and Cable Fittings
 - 4. UL 1063: Machine Tool Wires and Cables
 - 5. UL 1277: Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
 - 6. UL 1581: Reference Standard for Electrical Wires, Cables, and Flexible Cords
- E. American Society for Testing and Materials (ASTM)
 - 1. ASTM B3: Soft or Annealed Copper Wires
 - 2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft
 - 3. ASTM B33: Tinned soft or annealed copper wire for electrical purposes
- F. Institute of Electrical and Electronics Engineers (IEEE), IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations
- G. IEEE 383: Vertical Wire Flame Test
- H. IEEE 1202: Flame testing of cables for use in cable tray
- I. Insulated Cable Engineers Association (ICEA)

1. ICEA S-61-402: Thermoplastic- Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC5)
2. ICEA S-66-524: Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-7)
3. ICEA S-68-516: Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-8)
4. ICEA S-95-658 Non-shielded Power Cable Rated 2000 Volts or Less
5. ICEA T-29-520 Flame Test

1.3 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.4 RECORD DRAWINGS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.5 OPERATIONS & MAINTENANCE MANUALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.6 Quality assurance

A. Tests:

1. Cable shall meet all the requirements of Part 6 of ICEA S-61-402
2. Cable shall be tested at the factory to confirm that the cable complies with requirements of ICEA Section 7.7.9 of S-66-524 or 7.5.9 of S-68-516
3. Where applicable, the cable shall meet the requirements of the vertical tray flame test as described in IEEE 383-2.5

PART II: PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Belden
- B. Cerrowire
- C. General Cable
- D. Okonite Company
- E. Service Wire Drive VFD Cable
- F. Southwire
- G. Or approved equal

2.2 MATERIALS AND EQUIPMENT

A. Design:

1. Provide cable designated as THWN/THHN or XHHW single conductor type and UL 83 and UL 1063 listed, rated 600 volts and certified for continuous operation at maximum conductor temperature of 90° C in dry locations and 75° C in wet locations while installed in underground duct, conduit or in control panels (MTW). Use XHHW, 90° rated conductors for main service or feeders
2. Provide cable with the following design characteristics. The cable shall consist of multiple conductors. The cable assembly shall be UL listed, flame, oil, and sunlight resistant, and certified for continuous operation at the temperature specified in wet or dry locations while installed in underground duct, conduit, or cable tray. The number and size of conductors supplied in each cable shall correspond to the quantities specified. Each conductor shall be individually insulated. Pairs and triads shall have conductors, which are twisted together with a drain wire, shielded, and covered with a jacket. Multi-pair/triad cables shall consist of the required number of electrically isolated, shielded pairs or triads, which are bundled together and covered by an overall jacket as specified

B. Conductors:

1. Provide conductors, which are Class B, concentric stranded, annealed un-coated copper with physical and electrical properties complying with ASTM B3 and B8 and Part 2 of ICEA S-61-402, S-66-524, or S-68-516, unless otherwise specified

C. Insulation:

1. Each conductor shall be PVC insulated and nylon jacketed to meet the requirements of Part 3 of ICEA S-61-402. The insulation thickness shall match the dimensions listed in NEC Table 310-13 for type THHN and THWN wire
2. Each conductor shall be insulated as specified in compliance the requirements of Part 3 of ICEA S-61-402, S-66-524, or S68-516. The average insulation thickness shall not be less than the dimensions shown in Table 7-32 or 7.5.1 of ICEA S-66-524 or S-68-516 for 600-volt insulation unless otherwise specified. The minimum insulation thickness shall not be less than 90 percent of the value given in the table

D. Shielding:

1. Provide shielding consisting of laminated, non-burning, mylar-backed aluminum tape applied helically around a twisted pair or triad with the aluminum side in continuous contact with the drain wire unless otherwise specified. Wrap the tape around each twisted pair or triad with a 25 percent minimum overlap unless otherwise specified

E. Drain Wire:

1. Provide drain wire, which is Class B, seven-stranded, tin-coated copper in accordance with ASTM B3, B8, or B33 and as specified. The drain wire shall not be less than two AWG sizes smaller than the insulated conductor's size, except for multiple pair triad drain wires, which shall not be less than the insulated conductor size

F. Jacket:

1. The physical and electrical properties of the jacket used to cover single or multipair or triad cables shall meet the requirements of section 7.7.7 or ICEA S-66-524 or section 7.5.6 of ICEA S-68-516. Jacket material as specified. The jacket thickness shall be equal to the dimensions shown in Table 7-33 or 7.5.2 of ICEA S-66-524 or S-68-516

G. Armor:

1. Where requested, use instrumentation cables protected by an interlocked metal tape armor coating made of galvanized steel, which meets the requirements of paragraph 4.5 of ICEA S-68-516 or S-66-524, unless otherwise specified

H. Wire Marking:

1. Wire marking shall be in accordance with NEC Article 310-11 and shall be printed on the wire insulation at 2-foot intervals
2. The printing method used shall be permanent and the color shall sharply contrast with the jacket color
3. Use individual conductors in single-pair and single-triad cables, which are, color coded black and white; and black, white and red, respectively. Multi-pair triad cables shall have one conductor in each pair or triad colored white, and all other conductors are color coded in sequence according to Table L-2 of Appendix 2 of ICEA S66-524, and as specified
4. Print cable marking information on the jacket of each cable at 2-foot intervals. Use a permanent printing method with color sharply contrasting the jacket color

I. The single conductor color coding shall be as follows:

System Voltage	A	B	C
Neutral			
120/240 Volt 1Ph/3w	Black	Red	White
120/208 Volt 3Ph/4w	Black	Red	Blue
120/240 Volt 3Ph/4w	Black	Orange	Blue
277/480 Volt 3Ph/4w	Brown	Purple	Yellow
Grey			

Motor Control	1 Black	
	2 Red	
	3 Blue	
	Ground	Green

- J. VFD cables are to be selected and provided for AC motor drive duty and shall be rated at voltage listed in VFD Manufacturer's data sheets
- K. All service and feeder conductors to be XHHW-2
- L. All conductors shall be soft-drawn, stranded annealed copper that meets ANSI 44, ASTM B3-74/38-72
- M. Insulation for all 480V conductors, insulated equipment grounding conductors and control conductors shall be type XHHW-2 For dry and wet locations; maximum operating temperature shall be 90°C. Meet UL 44 and Federal Spec A-A-59544
- N. All power conductor cables shall have phase colored insulation
- O. Insulation for all 120/240V conductors, insulated equipment grounding conductors and control conductors shall be type XHHW-2 For dry and wet locations; maximum operating temperature shall be 90°C. Meet UL 44 and Federal Spec A-A-59544
- P. Multiconductor shielded cables shall be polyethylene insulated tinned copper conductors within an aluminum-polyester shield tinned copper drain wire and a chrome PVC jacket. Shield shall provide 100% coverage. Cables shall be UL style 2092 and shall be Beldon Beldfoil #8760 or equal, with number of conductors shown. Minimum conductor size shall be #18AWG
- Q. Multiconductor signal cables shall consist of twisted pairs of insulated copper conductors, size and number of pairs as indicated, with a petroleum-polyethylene compound which fills all cable interstices, a non-hygroscopic core tape, .005" copper shield and a polyethylene jacket. Cable shall be manufactured to REA Specification PE-39 for REA designation BJCF cables and shall be Okonite type KTC-F or equal
- R. All control panel wiring shall be tinned stranded #14 AWG minimum size conductors for controls with type SIS insulation
- S. Ethernet cable to be CAT6

2.3 INSULATING PRODUCTS

- A. Tape products shall be furnished as hereinafter specified and shall be Plymouth, Okonite, F.E., 3M, or equal
- B. General purpose electrical tape shall be 7 mil thick stretchable vinyl plastic, pressure adhesive type, "slipknot Grey", 3M Scotch 33+, or equal

- C. Insulating void-filling tape and high voltage bedding tape shall be stretchable ethylene propylene rubber with high-tack and fast fusing surfaces. Tape shall be rated for 90 degrees Celsius continuous, 130 degrees Celsius overload, and shall be moisture-proof void filling tape shall be "plysafe", 3M Scotch 23, or equal
- D. High temperature protective tape shall be rated 180 degrees Celsius continuous indoor/outdoor, stretchable, self-bonding silicone rubber. High temperature tape shall be "Plysil #3445", 3M Scotch 70, or equal
- E. Insulation putty filler-tape shall be Plymouth #2074, 3M, or equal

2.4 WIRING DEVICES

- A. All wiring devices shall be specification grade and shall meet NEMA WD 1-1971 requirements. Furnish following types unless otherwise indicated
- B. GFI receptacles shall be 20A duplex receptacle in a duplex body containing reset and test pushbuttons. Furnish Square D "GFCI-WR", or equal
- C. Single-pole, single throw, 20A toggle switch shall be Arrow-Hart #1791, Hubbell #1221, or equal
- D. Door switch, single-throw pressure sensitive shall be Pass & Seymour #1205, or equal
- E. Wiring devices are to be ivory in color

2.5 MISCELLANEOUS MATERIAL

- A. Cable grips shall be 316 stainless steel, grip-type wire mesh with machined metal support. Furnish Kellems, Appleton, or equal products
- B. Conduit pull-cords for use in empty raceways shall be glass-fiber reinforced tape with foot-marked along its length. Furnish Thomas, Greenlee, or equal products
- C. Conduit thread coating compound shall be conductive, non-galling, and corrosion-inhibiting and applied to all threads. Furnish Crouse-Hinds type "STL", Appleton type "ST", Noalox, Penetrox or equal
- D. Wire pulling compound shall be non-injurious to insulation and to conduit and shall be lubricating, non-crumbling, and non-combustible. Furnish clear wire pulling compound
- E. Plastic compound for field-coating of ferrous material products shall be PVC in liquid form that sets-up semi-hard upon curing. Furnishing Rob Roy "rob Kote", Sedco "Patch Coat", or equal
- F. Zinc spray for coating electrogalvanized steel products shall be Research Laboratory type "LPS", Mobil "Zinc-spray", or equal
- G. Splicing kit shall be provided with insulating and sealing compound to provide a moisture-tight splice. Provide Scotchcast Series 82 or equal splicing kit

2.6 CONNECTORS

- A. Power connectors shall be insulated tap connectors. Furnish NSI Polaris connectors with no equals
- B. Insulated silicone filled spring-wire connectors, "wire-nuts", for small building wire taps and splices shall be plated spring steel with thermoplastic jacket. Connector shall be rated at 150 degrees Celsius continuous. Furnish 3M "or equal
- C. Insulated set-screw connectors shall consist of copper body with flame-retardant plastic insulated shield. Furnish Ideal, T&B, or equal
- D. Connectors for control conductor connections to screw terminals shall be crimp-type with vinyl insulated barrel and tin-plated copper ring-tongue style connector. Furnish T&B "Sta-kon", 3M "Scotchlok", or equal

2.7 VFD RATED CABLE AND CONNECTORS

- A. General
 - 1. Provide power and control multiconductor and connector system for variable frequency drives with service in a corrosive industrial environment up to 600V AC.
- B. Scope
 - 1. (3) copper phase conductors with 2kV RHW-2 90° C insulation
 - 2. (3) equally spaced bare copper equipment grounding conductors
 - 3. Helically applied copper tape shield with minimum 50 percent overlap
 - 4. Outer jacket
 - 5. Connectors and accessories
 - 6. Termination Kits
 - 7. The minimum cable bending radius shall be a maximum of 10 times the overall cable diameter
- C. Conductors
 - 1. Conductor shall be the size specified, made of soft annealed stranded bare or tinned copper with Class B concentric stranding in accordance with ICEA (Insulated Cable Engineers Association) S-95-658, Tables 2-1, 2-3, and G-2.
- D. Conductor Insulation
 - 1. Phase conductor insulation shall be moisture resistant, flame-retardant cross-linked polyethylene (2kV RHW-2) suitable for 90° C conductor temperature operation in dry, damp and wet locations. Thermoplastic and non-flame-retardant insulations are not acceptable. The minimum insulation thickness shall not be less than 90% of the minimum average thickness shown in Section 6.0.

E. Fillers

1. Fillers of nonconductive and nonmetallic material may be cabled with the conductors to make the finished cable round and firm at all points as described in UL 1277, section 10.2.1.

F. Ground Wires

1. Ground wires for (3) conductor cables shall be three bare or tinned copper wires, one located in each interstice and equidistant from the phase conductors.

G. Shield

1. A copper tape shield shall be provided over the cable core and below the outer jacket. The tape shield shall be helically applied minimum 5 mils thick bare copper with minimum 50% overlap to assure full coverage at the cable bends.

H. Outer Jacket

1. The outer jacket shall be solid black and shall be moisture, chemical and sunlight resistant. Thermoset (e.g. CSPE or CPE-TS), thermoplastic (e.g., PVC or CPE-TP) and Low Smoke Zero Halogen (LSZH) jacket materials are acceptable. The minimum jacket thickness shall meet or exceed the requirements of ICEA S-93-658, Table 4-4.

I. Identification

1. Identification shall consist of readable printing on the cable jacket indicating number and size of conductors, cable type, voltage, UL listing, manufacturer's cable number and name, and year of manufacture.
2. Phase identification shall comply with either ICEA method 3 (black, red and blue insulation) or method 4 (surface printing of numbers).

J. Connectors

1. The cable systems' connectors shall be watertight, and UL listed for installation.
2. The connector body material shall be nickel clad aluminum. The cable connector shall provide a 360-degree electrical bonding of the copper tape shield to the connector body.
3. Connection of the copper tape shield to the connector body shall be accomplished by an integral and self-retaining grounding collar that automatically provides a 360-degree connection as the connector is tightened. The connector assembly shall be designed to ensure against loosening of threads due to vibration.
4. A UL listed chrome plated grounding and bonding locknut with a 360-

degree knurled teeth connection shall be provided with each connector to secure and bond the connector to the inverter cabinet / motor termination box. In addition, tinned copper braids (minimum $\frac{3}{4}$ inches wide) with installation hardware to connect the copper tape shield to the inverter enclosure / backpanel and to the motor frame shall be provided as part of the cable system.

K. Termination Kits

1. Tinned copper braids (minimum $\frac{3}{4}$ inches wide) with installation hardware to connect the copper tape shield to cable core, to the inverter enclosure / back-panel, and to the motor frame shall be provided as part of the cable system.
2. Braid width shall be determined by cable core diameter size and shall be placed at a separation of 180 degrees.

L. DOCUMENTATION

1. The cable manufacturer shall provide clear and concise cable / connector installation instructions (including cable termination / connector assembly instructional DVD) and generic guidelines on how to ensure a long-term high frequency bond connection between the motor frame and drive backplane. The vendor shall furnish pictures of typical installations with proper high frequency bonding.

PART III: EXECUTION

3.1 TESTING

A. Tests:

1. In general, test insulation integrity of the wiring system before terminating
2. Make sure to disconnect sensitive electronic equipment before testing insulation
3. Use a 500 VDC megohmmeter and perform the wire system insulation test in accordance with the operating instructions
4. Before connecting the cables, test insulation integrity and conductor continuity
5. All cables shall have an insulation test performed using 1000-volt megger that has been calibrated within the last twelve months.
6. Cables installed with an insulation reading less than 500 megohms shall be removed and new cable installed and retested at no additional cost to the owner.
7. Cables installed with an unacceptable insulation reading shall be removed and new cable installed and retested at no additional cost to

the owner. Submit cable megger test report to owner's representative.

8. The grounding system shall be tested in the presence of the owner's representative using the fall of potential method and shall provide a grounding system resulting in an ohmic value of five (5) ohms or less at no additional cost to the owner. The contractor shall submit test report to owner's representative. Test equipment must be calibrated within the previous 12 months. Provide dated calibration results along with submittal.

3.2 PREPERATION

- A. Ship wire and cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by using manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable
- B. Complete the cable raceway systems and underground duct banks before installing cables
- C. Verify sizing of raceways and pull boxes to ensure proper accommodation for the cables
- D. Check the length of the cable raceway system against the length of cable on the selected reel
- E. Clean conduits of foreign matter before cables are pulled
- F. Preparation for termination:
 1. Make 600-volt power cable terminations and splices with heat shrinkable sleeves and seals
 2. Terminal lugs and connectors for all sizes of conductors shall be crimp-on type
 3. For size 1/0 AWG and larger, crimp-on lugs shall have the long barrel with 2-hole tongues except in places where termination space is limited
- G. Do not install or work on PVC insulated or jacketed cables in temperatures below 32-degrees F
- H. Provide at least 30 percent spare conductors or pairs

3.3 INSTALLATION

- A. Wiring Methods
 1. Use wiring methods indicated on the Drawings
 2. In general, use THHN/THWN or XHHW building wire for lighting, power and control wiring where conductors are enclosed in raceways such as above ground conduit system, underground duct banks, or inside

control panels. Use XHHW, 90° rated conductors for main service or power and motor feeders

3. Do not use solid conductors
4. Use conductors no smaller than No. 12 AWG stranded for lighting circuits indoors and not smaller than No. 10 AWG stranded for outdoors. Use No. 10 AWG (minimum) for outdoor receptacles on structures or poles
5. Use conductors no smaller than No. 14 AWG for control circuits, except when part of a multi-conductor cable or internal panel wiring
6. In general, do not splice conductors. All conductors must be one continuous length from starting point to end point without splices, unless prior written approval by Engineer
7. Splices associated with taps for lighting and control circuits are allowed without approval
8. Make splices in accessible junction boxes located above ground. Do not splice power and control conductors in underground pull boxes or manholes, unless specifically allowed. Any splices allowed in underground boxes shall be made using 3M liquid tight kits specifically made to withstand submergence in water. Any conductors allowed to be spliced in underground boxes shall have conductors elevated to near top of wall
9. Wire nuts with insulated caps may be used for lighting wiring splices located in wall boxes, switch boxes, and receptacle boxes, but not in control panels, MCC's or underground boxes. Splice control circuit with insulated crimp connectors
10. All conductors routed in manholes, electrical vaults and underground pull boxes shall be routed around walls and supported by nonmetallic fiberglass strut that is bolted vertically to walls at intervals not less than two per wall. Do not use horizontal arms unless specifically called for. Support conductors with stainless steel bands made for the purpose of supporting conductors, or with large wide nylon Ty-Wraps. Under no conditions shall conductors be routed directly across length of box. Any conductors routed otherwise shall be removed and replaced at Contractors expense. Splicing in UG pull boxes, manholes or vaults is prohibited without written approval by Engineer

B. Single Conductor in Conduit and Ductbank

1. Install cables in accordance with the manufacturer's instructions and NEC Chapter 3 - Wiring Methods and Materials. Do not exceed maximum wire tension, maximum insulation pressure and minimum bending radius
2. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation

3. Splices are not allowed in manholes
- C. Single Conductor in Cable Tray:
 1. Do not install single conductor building wire and cable in cable tray. All conductors to be tray rated composite cable type
- D. Multi-Conductor Shielded VFD Rated Cable:
 1. Install cables in accordance with the manufacturer's instructions
 2. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation
 3. Do not splice cables unless specifically shown on plans. Provide as one continuous length. Where splicing is shown on plans or approved, use mechanical compressing tools and splice barrels only, and tape connections
 4. All cables and conductors routed thru UG pull boxes or manholes shall be routed around walls and secured on racks. See plans for details
- E. Termination:
 1. After the 600-volt wiring system has been tested with satisfactory results, reconnect wire
 2. Do not splice conductors. For termination use crimp-on type ring tongue non-insulated tin-plated copper lugs
 3. For shielded control cable, terminate the shield and ground it at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables
 4. If splicing is required, maintain shield continuity by jumpering the ground shield across connection point where it is broken at junction boxes, or other splice points. Insulate these points from ground
 5. Mark wiring on both ends with circuit numbers or loop tag numbers. Heat shrink wire markers after the ring tongue terminal has been installed. Extend the marker over the crimp or base of the terminal
- F. Conductors shall be sized as shown and where no size is indicated, the conductor size shall be size #12 AWG
- G. Insulation for all conductors, insulated equipment grounding conductors and control conductors shall be stranded copper type XHHW-2 for dry and wet locations; maximum operating temperature shall be 90°C (XHHW-2). UL listed as gasoline and oil resistant. PVC insulation with nylon outer jacket. Meet UL 83 and Federal Spec J-C-30B
- H. Branch circuits may be spliced for receptacle and lighting loads inside appropriate junction boxes. All control and power cables shall be run continuous without splices except where approved by the engineer
- I. Except as otherwise specified, taps and splices for receptacles and lighting

shall be made with silicone filled spring wire connectors

- J. Motor connections and all taps and splices other than for receptacle and lighting shall be made with the appropriate NSI Polaris series connectors
- K. Control wiring connections to stud type and screw type terminals shall be made with ring-tongue type crimp connectors. Label each terminal jacket with wire marking label at each connection
- L. Each wire connection shall be made up tightly so that resistance of connection is as low as equivalent length of associated conductor resistance
- M. All wiring inside enclosures will be neatly trained and laced with nylon tie-wraps
- N. All wiring shall be installed in raceways except inside the wet well; however, no wire shall be drawn into a conduit until all work of a nature which may cause injury is completed. Do not exceed wire and cable manufacturer's recommended pulling tensions. A cable pulling compound shall be used as a lubricant and its composition shall not affect the conductor or its insulation
- O. Install wiring devices where indicated. Wiring devices shall be type as indicated
- P. Each wiring device shall be set with axis plumb and installed with yoke screw so as to adequately support device yokes to the box. Install ground prong pointed up
- Q. Device boxes shall be type FS or FD cast aluminum
- R. Use aluminum ganged boxes for ganged devices. "Type FD sand cast aluminum boxes are required
- S. Each device box shall be equipped with specified aluminum cover and 316 S.S. hardware

3.4 REPAIR/RESTORATION

- A. Inspection of Conductors
- B. All conductors shall be inspected for damage after pulled in conduit. Where damage is deemed excessive by Engineer, conductors shall be replaced for entire length of run
- C. Where damage is due to condition of conduits, Contractor may be requested to provide a televised inspection of conduits at no additional cost to Owner and where deemed necessary by Engineer, any damaged conduits shall be replaced at no additional cost to Owner

END OF SECTION

Section 16131 Raceways and Boxes

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. This specification will cover device boxes, pull boxes, junction boxes, and raceways not covered in other sections

1.2 REFERENCES

- A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)
 - 1. FB1 - Fittings and Support for Conduits and Cable Assemblies
 - 2. 250 - Enclosures for Electrical Equipment (1000 volts maximum)
- B. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA70 - National Electrical Code (NEC) - Article 314 – outlet device, pull and junction boxes, conduit bodies and fittings
- C. Underwriters Laboratories (UL):
 - 1. 50 - Safety Cabinets and Boxes
 - 2. 508 - Safety Industrial Control Equipment
 - 3. 514B - Safety Fittings for Conduit and Outlet Boxes
 - 4. 886 - Safety Outlet Boxes and Fittings for Use in Hazardous Areas.

1.3 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051
- B. Installation instructions
- C. Dimensions and weights

1.4 RECORD DRAWINGS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.5 OPERATIONS & MAINTENANCE MANUALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

PART II: PRODUCTS

2.1 ACCEPTABLE MANUFACTURER'S

- A. Sheet Metal Boxes
 - 1. Hoffman Industrial Products
 - 2. Robroy
 - 3. Eaton/Crouse-Hinds
 - 4. Rittal
- B. Cast Device Boxes
 - 1. Appleton Electric Company
 - 2. Eaton/Crouse-Hinds
 - 3. Hubbel/Killark
- C. Pull box
 - 1. Oldcastle
 - 2. Cesco
 - 3. Rexel USA
 - 4. Utility Concrete Products
 - 5. Jensen Precast
 - 6. Or approved equal

2.2 MATERIALS AND EQUIPMENT

- A. Sheet metal boxes
 - 1. Provide UL-approved junction boxes and pull boxes manufactured from stainless steel sheet metal and meeting requirements of NEMA 4X for corrosive and wet areas, NEMA 250 and NEC Article 314. Enclosures located outdoors or in environmentally harsh or wet locations shall be NEMA 4X 316 stainless steel
 - 2. Provide boxes with a stainless-steel continuous hinge, closure hasps and all stainless-steel hardware
 - 3. Furnish the door with neoprene gasket and provision for padlock
- B. Device boxes
 - 1. Provide UL-approved boxes designed and manufactured to house electrical devices like receptacles and switches, and in conformance with NEMA FB1 and NEC Article 314
 - 2. Supply boxes that are hot dip galvanized on cast iron suitable for

- corrosive and wet atmosphere
- 3. All boxes located in environmentally harsh or wet or outdoor locations shall be NEMA 4X 316 stainless steel
- 4. All boxes located in chemical rooms shall be H.D. PVC only
- 5. Where unprotected service conductors are routed through a pull box with other conductors a divider wall shall be provided in the pull box for separation as required by the NEC
- C. Hardware
 - 1. Mounting Hardware: Stainless steel
 - 2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal
- D. Pull Box
 - 1. Minimum size 24" x 24"
 - 2. Pull box shall be traffic rated
 - 3. Pull box shall be aircraft rated where shown on plans
 - 4. Modular construction
 - 5. Base/bottom section
 - 6. Lockable cover

PART III: EXECUTION

3.1 preperation

- E. Pack and crate boxes to permit ease of handling and to provide protection from damage during shipping, handling, and storage
- F. Review the drawings and determine how many boxes of each kind are required and check if supplied quantity is sufficient

3.2 Installation

- G. Boxes described in this specification shall be used both in dry and wet, corrosive areas, both inside and outside locations
- H. B. Install boxes in accordance with NEC Article 314 in locations indicated on the Drawings
- I. Install junction and pull boxes in readily accessible places to facilitate wire pulls, maintenance, and repair
- J. Plug unused conduit openings
- K. Make conduit connections to sheet metal boxes with watertight conduit connectors
- L. Size underground pull boxes and manholes large enough to allow cables and conductors to be routed around walls and supported on wall racks. See

plans for details. Do not use arms on mounted racks, except for MV cables or large multiple 600 Volt cables. Do not cross and occupy middle of pull box or manhole with cables or conductors

END OF SECTION

Section 16132 Conduit, Fittings, and Bodies

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. This specification covers all requirements for conduits, fittings, and bodies for various service and electrical equipment
- D. All equipment described herein shall be submitted, and factory installed, as an integral part of equipment specified in overall construction documents

1.2 PRICE AND PAYMENT PROCEDURES

- A. No separate payment for work performed under this section. Include cost for conduits, fittings, and bodies in overall electrical equipment

1.3 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. ANSI C80.1: Rigid Steel Conduit - Zinc Coated
 - 2. ANSI C80.4: Fittings for Rigid Metal Conduit
- B. Federal Specifications
 - 1. W-C-58C: Conduit Outlet Boxes, Bodies Aluminum, and Malleable Iron
 - 2. W-C-1094A: Conduit and Conduit Fittings Plastic, Rigid
 - 3. WW-C-566C: Flexible Metal Conduit
 - 4. WW-C-581E: Coatings on Steel Conduit
- C. National Electrical Manufacturers Association (NEMA)
 - 1. NEMA RN1: Polyvinyl Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing
 - 2. NEMA TC2: Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
 - 3. NEMA TC3: PVC Fittings for Use with Rigid PVC Conduit and Tubing
- D. National Fire Protection Association (NFPA), ANSI/NFPA 70 - National Electrical Code (NEC)
- E. Underwriters' Laboratories (UL)
 - 1. UL 1: Flexible Metal Electrical Conduit
 - 2. UL 6: Rigid Metal Electrical Conduit

3. UL 514B: Fittings for Conduit and Outlet Boxes
4. UL 651: Schedule 40 and 80 Rigid PVC Conduit
5. UL 651A: Type EB and A Rigid PVC Conduit and HDPE Conduit
6. UL 886: Electrical Outlet Boxes and Fittings for Use in Hazardous Locations
- F. ETL verified PVC-001 for PVC coated rigid steel conduit
- 1.4 SUBMITTALS
 - A. Refer to specification for Basic Submittal and O&M Requirements 16051
- 1.5 RECORD DRAWINGS
 - A. Refer to specification for Basic Submittal and O&M Requirements 16051
- 1.6 OPERATIONS & MAINTENANCE MANUALS
 - A. Refer to specification for Basic Submittal and O&M Requirements 16051
- 1.7 QUALITY ASSURANCE
 - A. Tests:
 1. Rigid steel conduit shall pass the bending, ductility, and thickness of zinc coating tests described by ANSI C80.1
 2. Flexible conduit shall pass the tension, flexibility, impact, and zinc coating test described by UL 1
 3. Nonmetallic conduit and fittings shall pass the test requirements of NEMA TC2, UL 651 and 651A and Federal Specification W-C-1094A

PART II: PRODUCTS

- 2.1 RACEWAYS
 - A. Acceptable manufacturer's
 1. Cantex
 2. Wheatland Tube
 3. ABB - Ocal
 4. Champion Fiberglass
 5. NEC Inc., - Black Guard
 6. Atkore - CALBOND
 7. Atkore - Heritage Plastics
 8. Allied Tube & Conduit
 9. Prime Conduit
 10. Emerson - O-Z/Gedney

11. Eaton/Crouse-Hinds
 12. Western Tube and Conduit
 13. Robroy – Plasti-Bond
 14. Or equal
- B. Materials and equipment
1. Design Conditions. Use electrical conduit, fittings, and bodies designed for service in areas as specified within this section to form a continuous support system for power, control, and instrument cables
 - a. Use PVC coated steel conduits and hardware for Wastewater Facilities or corrosive environments
 - b. Use rigid galvanized steel conduits for Water Facilities
 2. Conduit and Fittings
 - a. Fiberglass Conduit – Above Ground
 - i. Listing: UL 2515 Above Ground Standard
 - ii. RTRC (Thermosetting Resin Conduit) manufactured by single circuit filament winding process. The resin shall be epoxy based, with no fillers.
 - iii. Manufacturer shall have a current ISO 9001 Quality Management System Certificate
 - iv. Toxicity: The conduit shall not contain any compounds that can release halogens (chlorine, bromine, fluorine, and iodine) in more than trace amounts when burning.
 - b. Fiber Glass conduit – XW Conduit
 - i. RTRC (Thermosetting Resin Conduit) manufactured by single circuit filament winding process. The resin shall be epoxy based, with no fillers.
 - ii. Manufacturer shall have a current ISO 9001 Quality Management System Certificate
 - iii. Toxicity: The conduit shall not contain any compounds that can release halogens (chlorine, bromine, fluorine, and iodine) in more than trace amounts when burning.
 - iv. Wall thickness: Minimum of .25"
 - c. Rigid Steel Conduit and Fittings:
 - i. Rigid steel conduit, rigid steel conduit bends, nipples, and bodies shall be hot-dipped galvanized and shall comply with the latest ANSI C80.1, UL 6, Federal Specification WW-C-581E, and NEC Article 344
 - ii. Mild steel tubing shall be used for conduit, nipples, and couplings, and shall be free of defects on both the inner and outer surfaces
 - iii. Fittings, bodies, and covers for rigid steel conduit shall be steel

- or cast-iron and shall comply with ANSI C80.4, UL 514B, and Federal Specification W-C-58C
- d. PVC-Coated Rigid Steel Conduit and Fittings.
 - i. PVC-coated conduit, fittings, bodies, and covers shall conform to NEMA RN1 (Type A). Rigid steel galvanized conduit and fittings before coating shall conform to Federal Specification WW-C-581E, ANSI C80.1, and UL 6. Conduit bodies shall conform to UL 514B and Federal Specification W-C-58C. Provide sufficient coating for touch up after installation
 - ii. PVC-coated couplings shall be of the ribbed type
 - iii. Condulet covers shall have encapsulated stainless steel thumbscrews
 - iv. Condulets and covers shall be of malleable iron or ferrous material before coating
 - v. PVC coating shall be a minimum of 2-mil thickness on the interior of the conduit and the interior of fittings, condulets, covers, and bodies
 - vi. Conduit clamps, strut, and devices shall be PVC coated when used with PVC-coated conduit
- e. Flexible and Liquid tight Flexible Metal Conduit and Fittings
 - i. Use liquid tight flexible metal conduit manufactured in accordance with UL 1 and Federal Specification WW-C-566C
 - ii. Fittings used with liquid tight flexible metal conduit shall be the PVC-coated type and of such design as to thoroughly ground the conduit to the fittings and through it to the box or enclosure to which it is attached
 - iii. Liquid tight flexible couplings and fittings for use in hazardous areas shall comply with UL 886, NEC Article 501-10 (A&B), and Federal Specification W-C-586C
 - iv. Do not use flexible metal conduit or liquid tight flexible metal conduit for light fixtures or receptacles unless shown on plans or approved by Engineer
- f. PVC Conduit and Fittings. Use PVC conduit, bends, and fittings, which comply with NEMA TC2, W-C-1094A, and NEC Article 352-III for above ground and underground installation. Conduit shall be Schedule 80, unless shown or noted otherwise on drawings or in other specifications
- g. Use PVC Schedule 80 conduits, fittings, and boxes for all chemical areas and provide conduit seals per NEC
- h. Aluminum RMC conduit may be used only where shown on plans
- i. Do not use liquid tight flexible metallic conduit to connect rigid conduit to fixed or wall mounted enclosures or panels
- j. Do not run liquid tight flexible metallic conduit directly thru walls, ceilings, or floors.

- k. Do not attach liquid tight flexible metallic conduit with nylon or plastic tie- wraps on straps. Use aluminum straps made for that purpose, except where approved by Engineer.
- C. Use UNY or UNF aluminum unions
- D. Conduit entrances into equipment shall be carefully planned. Cutting away of enclosure structure, torching out sill or braces, and removal of enclosure structural members, will not be acceptable
- E. Below-grade to above-grade upturns in non-metallic runs shall be made with ETL-PVC-001 compliant PVC coated rigid metallic conduit including 90-degree bends
- F. Above ground conduit shall be pvc coated rigid galvanized steel 1 in. minimum and shall comply with Article 346 of NEC and U.L. standard UL-6.
- G. Below grade conduit shall be non-metallic rigid PVC Schedule 80 1 in. minimum, rated 90 degrees Celsius and conform to NEMA TC-2 and UL-651 Standards, transitions to above ground to be made with PVC coated hot dipped rigid steel conduit that is ETL-PVC-001 compliant.
- H. Limited use of flexible conduit may be allowed if approved by the inspector. Use type LFNC flexible seal tight for 3/4 in. minimum thru 2 in. sizes, connectors shall be UL listed. Use aluminum core liquid tight flexible metal conduit for sizes 2 1/2 in. and larger, connectors shall be aluminum. All conduit shall be mounted on strut

2.2 CONDUIT FITTINGS

- A. Field applied hubs for all enclosure type entries shall be aluminum with grounding type lock ring, nylon throat, threaded NPT insert and shall be MYERS "SCRU-TITE", or equal
- B. Rigid metallic conduit chase nipples, slip fittings, unions, reducers shall be aluminum
- C. Limited use of flexible conduit may be allowed if approved by the inspector. Use type LFNC flexible seal tight for 3/4 in. minimum thru 2 in. sizes, connectors shall be UL listed. Use aluminum core liquid tight flexible metal conduit for sizes 2 1/2 in. and larger, connectors shall be aluminum. All conduit shall be mounted on strut

2.3 BODIES AND BOXES

- A. Conduit bodies such as "C", "LB", "T" and the like pulling fittings shall be sand-cast copper free steel. Covers shall be gasketed 316 stainless steel cover screws and clamp style attachment. Furnish Crouse-Hinds Form 7, or equal
- B. Cast metal outlet boxes, pull boxes, and junction boxes whose volume is smaller than 100 cubic inches, and cast metal device boxes, shall be sand-cast copper free. All boxes shall have threaded hubs. Furnish Crouse-Hinds "FD" style Condulets, Appleton "FD" style Unilets, or equal

- C. Covers for cast aluminum boxes shall be gasketed aluminum covers with 316 stainless steel screws. Furnish Pass & Seymour series WIUCast for receptacle covers and Cantex single gang toggle switch covers for light switches

PART III: EXECUTION

3.1 PREPERATION

- A. Package conduit in 10-foot bundles maximum with conduit and coupling thread protectors suitable for indoor and outdoor storage. Package fittings in manufacturer's standard quantities and packaging suitable for indoor storage. Package plastic-coated rigid conduit, fittings, and bodies in such a manner as to protect the coating from damage during shipment and storage
- B. Store conduit above ground on racks to prevent corrosion and entrance of debris
- C. Protect plastic conduit from sunlight
- D. Confirm submittal of shop drawing with conduit and conduit fitting, sizes, types, and routing shown
- E. Ensure that the conduit system to be installed is sized properly for the cable and wire requirements
- F. Verify the actual physical conduit route from the conduit plan drawings and prepare the conduit support system
- G. Verify the equipment locations to which the conduit will be connected and determine detail requirements for connections.
- H. Submit layout of all conduit stub-ups for Engineers review before installing conduits. Do not install conduit to equipment, electrical panels or devices until enclosure locations and sizes have been determined and verified by Supplier.

3.2 INSTALLATION

- A. Conduit bodies such as "LB", "T", etc., shall be installed in exposed runs of conduit wherever indicated and where required to overcome obstructions and to provide pulling access to wiring. Covers for such fittings shall be accessible and unobstructed by the adjacent construction. All conduit fittings shall be form 7 sand cast aluminum with aluminum covers and 316 S.S. hardware
- B. Covers for conduit bodies installed shall match the conduit material being installed
- C. No more than 270 degrees of bends shall be used in conduit runs
- D. Empty conduits shall have pull-tape installed. Identify each terminus as to location of other end. Use blank plastic waterproof write-on label and write information on each label with waterproof ink. Cap exposed ends of empty

- conduit with threaded plastic caps
- E. Conduit runs into boxes, cabinets, and enclosures shall be set in a neat manner. Vertical runs shall be set plumb. Conduits set cocked or out of plumb will not be acceptable. Use aluminum grounding type myers hubs with insulated throats for all enclosure entries
 - F. All raceways shall be swabbed clean after installation. There shall be no debris left inside. All interior surfaces shall be smooth and free from burrs and defects that would injure wire insulation. All conduits shall be sealed after cable installation with electrical insulation putty
 - G. Each flex connector shall be made-up tightly so that the minimum pull-out resistance is at least 150 lbs.
 - H. Rigid metallic conduit runs shall have their couplings and connections made with screwed fittings and shall be made up wrench tight. Check all threaded conduit joints prior to wire pull
 - I. All conduit runs shall be watertight over their lengths of run except where drain fittings are indicated. In which cases, install specified breather-drain fittings. Use aluminum seal-off fittings where required by NEC. Seal with 3M-2123 re-enterable sealing compound
 - J. LFNC conduit shall be used to connect wiring to limit switches, bearing thermostats, and other devices that may have to be removed for servicing. Unless otherwise indicated, maximum lengths of flex shall be six (6') feet
 - K. Install the conduit system to provide the facility with the utmost degree of reliability and maintenance free operation. The conduit system shall have the appearance of having been installed by competent workmen. Kinked conduit, conduit inadequately supported or carelessly installed, do not give such reliability and maintenance free operation and will not be accepted
 - L. Raceways shall be installed for all wiring runs
 - M. Conduit sizes, where not indicated, shall be N.E.C. code-sized to accommodate the number and diameter of wires to be pulled into the conduit. 3/4" trade-size shall be minimum size conduit except for conduits installed in duct banks which shall be a minimum 1" trade-size
 - N. Unless otherwise noted, conduit runs shall be installed exposed. Such runs shall be made parallel to the lines of the structure. Aluminum rigid conduit shall not come in contact with concrete
 - O. All raceway systems shall be adequately and safely supported. Loose, sloppy and inadequately supported raceways will not be acceptable. Supports shall be installed at intervals not greater than those set forth under Article 300 of N.E.C., unless shorter intervals are otherwise indicated, or unless conditions require shorter intervals of supports
 - P. Surface mounted runs of conduit on concrete or masonry surfaces shall be supported off the surface by means of 316 stainless steel slotted channels and conduit clamps. Attach each slotted channel support to concrete

- surface by means of two (2) 1/4" diameter 316 stainless steel bolts into drilled expansion shields
- Q. Conduit runs that are installed along metallic structures shall be supported by means of 316 S.S. beam clamps or other methods as may be indicated
- R. Below-grade conduits shall be supported with plastic saddles
- S. Install PVC-coated conduits in all locations at wastewater facilities, inside valve vaults, in wet well slabs, in corrosive and wet environments, in chemical rooms (Schedule 80 required) and, where specifically noted on drawings. Aluminum PVC-coated conduit may be used where specifically shown on plans, where specifically noted in specifications or where approved in writing. Install PVC coated conduits in Water Facilities where wet locations, inside valve vaults, or where specifically shown on Plans or noted in other Specifications
- T. Install rigid galvanized steel (RGS) conduits in dry inside locations and in all outdoor locations for water facilities and, where specifically noted otherwise on drawings. Aluminum RMC may be used where specifically shown on plans, where specifically noted in specifications or where approved in writing. Where aluminum conduit is approved, use all aluminum condulets and fittings
- U. Install PVC conduits in duct banks. For stub-ups and directional turn elbows, use PVC-coated rigid steel elbows or rigid steel elbows as applicable in A and B above and other specifically noted locations on drawings. Rigid steel stub-up shall have minimum three (3) layers of mylar tape up to 1" above slab where conduit is in contact with concrete. Stub-ups inside MCC's, panels, equipment and/or enclosures shall have threads with grounding bushings installed. Stub up all conduits entering MCC's, and other equipment enclosures from the bottom into each respective starter, feeder breaker or control section per equipment manufacturers conduit layout detail. Coordinate with equipment manufacture data sheets before starting any underground or below slab conduit installations
- V. Run exposed conduit parallel or perpendicular to walls, ceilings, or main structural members. Group multiple conduits together where possible. Do not install conduit where it interferes with the use of passageways, doorways, overhead cranes, monorails, equipment removal areas or working areas. In no case shall conduit routing present a safety hazard or interfere with normal plant operating and maintenance procedures. Maintain a minimum overhead clearance of 8'0" in passageways. Except where absolutely impossible, all conduits are to be installed in or under concrete slab, in walls and ceilings. Any exposed conduit installed otherwise may be relocated at Contractor's expense where directed by Engineer or Owner. Exceptions, where specifically noted otherwise on plans
- W. Installation and support of conduit shall be from steel or concrete structures

- in accordance with the standard detail drawings. Furnish necessary conduit straps, clamps, fittings and support for the conduit in accordance with the standard details and consistent with the grade and type of conduit being installed
- X. Identify conduit at termination points like MCC, light fixtures, control panels, receptacles, and junction boxes. Tag all conduits per Section 16052 – “Electrical Identification.”
 - Y. Not more than three (3) equivalent 90-degree bends will be permitted between pull boxes, or between pull boxes and equipment. Provide bonded expansion fittings at building expansion joints. Where pull boxes are located such the three 90-degree bend rule is not exceeded without the pull box, the box may be deleted where approved by Engineer in writing
 - Z. Install conduit runs so that they are mechanically secure, mechanically protected from physical harm, electrically continuous, and neat in appearance. The interiors of conduit shall provide clean, smooth raceways through which conductors may be drawn without damage to the insulation. Make threaded connections wrench tight
 - AA. Cut conduit square with a power saw or a rotary type conduit cutter designed to leave a flat face. Do not use plumbing pipe cutters for cutting conduit. Ream the cut ends of conduit with a reamer, designed for the purpose to eliminate rough edges and burrs. Cut threads with standard conduit dies providing 3/4-inch taper per foot, allowing the proper length so that joints and terminals may be made up tight and the ends of the conduit not deformed. Keep dies sharp and use a good quality threading oil continuously during the threading operation. Remove metal cuttings and oil from the conduit ends after the threads are cut and paint threads before connections are made. Use zinc rich, brush-on compound on the threads of steel conduit before connections are made. Use only tools specifically made for bending and installing PVC-coated or PVC conduit when installing these materials
 - BB. Use strap wrenches only to tighten joints in plastic coated rigid steel conduit. Replace all conduit and fittings with damage to the plastic coating, such as cuts, nicks and threader chuck jaw marks
 - CC. Make up changes in direction of exposed conduit using elbows or fittings. Do not use pull boxes to make direction changes unless specifically designated otherwise. Do not use elbow bends for change in direction of exposed conduit
 - DD. Field fabricated bends shall be free of indentations or elliptical sections. The radius of the bend shall not be less than 6 times the smallest diameter of the raceway
 - EE. Protect all conduit terminations from mechanical injury. Prevent the entry of moisture and foreign matter into the conduit system by properly capping terminations

- FF. Avoid trapped runs of conduit, if possible. When they are necessary, provide drainage using a “tee” conduit equipped with a drain. Conduit is likely to pass through areas with a temperature differential of 20 degrees F or more. Seal penetrations with a proper seal fitting at the wall or barrier between such areas. For conduit passing through walls separating pressurized areas from non-pressurized areas, install sealing fittings at the wall on the non-pressurized side
- GG. Fit conduit crossing building or structure expansion joints with approved expansion fittings, except that fittings will not be required when conduit crossing an expansion joint is supported on trapeze hangers in such a way that at no time will the conduit be under stress due to expansion. Install bonding jumpers around expansion joint fittings
- HH. Where conduit terminates in sheet metal enclosures, threaded hubs are required. Conduit entries with double locknuts and bushings are prohibited. Sheet metal enclosures located outside or in any other wet, damp, or corrosive areas shall be furnished with threaded hubs. Restrict side penetrations to the lower one third of the enclosure
- II. Provide liquid tight flexible metallic conduit only where necessary to allow for movement or to localize sound or vibration, at transformers, at motors, solenoid valves, motor operated valves, generators, and any other rotating equipment unless shown otherwise on Drawings. Do not make rigid connections of conduit to vibrating equipment housing or frame. Limit length to less than 2 feet. Do not use flexible metallic conduit for light fixture circuits or similar devices and do not use as a substitute for rigid conduit
- JJ. Seal openings or holes where conduits pass through walls or floors. When conduits are passing through a firewall or fire-rated floor into different rooms, cabinets, or enclosures, use a fire-rated seal as shown in the typical detail included in the drawings. Certain walls, where indicated on the Drawings, require environmental (airtight) seals; seal as shown
- KK. Install explosion-proof seals in conduit runs crossing or entering a hazardous classified area, where shown on Drawings. Install type CSBE removable sealing fittings to seal pump cables in the wet well and at the first junction box outside the well. Install EYS seals in all conduits leaving chemical rooms or chemical storage spaces. There shall be no unions, couplings, boxes, or fittings in conduit run between seal and point at which conduit leaves the room
- LL. Unless otherwise indicated on the Drawings, install expansion fittings every 300 feet within a straight conduit run and where conduit crosses building expansion joints, using bonding straps to ensure ground continuity
- MM. Parallel runs of conduit may be supported by structural steel racks. When two or more racks are arranged one above the other, provide vertical separation of not less than 12 inches between racks, unless otherwise indicated on the Drawings. Space conduits on the racks at least enough to provide 1/4-inch clearance between hubs on adjacent conduits at

- terminations and to allow room for fittings
- NN. Fill conduit racks no more than 75 percent of their capacity, providing usable space for future conduit. To ensure this, conduits leaving the rack horizontally shall be offset up or down so that future conduits may be installed in the space remaining. Construct conduit racks to permit access for wire or cable pulling at all pull points, even when future conduits are added to fill the racks
- OO. Where conduit racks are supported on rods from beam clamps or by some other non-rigid suspension system, install rigid supports at no more than 50-foot intervals to give lateral stability to the rack
- PP. Conduit racks or hangers must in no way interfere with machinery (or its operation), piping, structural members, process equipment, or access to anticipated future equipment. Refer to architectural, structural, equipment layout and piping drawings to ensure that this requirement is met
- QQ. Label high voltage conduit with the circuit phase-to-phase voltage by means of a firmly attached tag or label of approved design at each conduit termination, on each side of walls or barriers pierced and at intervals not exceeding 200 feet along the entire length of the conduit
- RR. Support conduit sizes 2 inches and larger at spacings not exceeding 10 feet and conduit sizes 1-1/2 inches and smaller at spacings not exceeding 8 feet
- SS. The means of fastening conduit to supports shall be by one-hole malleable iron conduit straps secured by wood screws to wood and by bolts with expansion anchors to concrete or masonry; by "Korn" clamps or U-bolts to other surfaces. Use "clamp backs" when strapping conduits to walls, column faces, or other such surfaces
- TT. Support conduit runs with conduit clamps, hangers, straps, and metal framing channel attached to structural steel members. Conduits of 1-1/2-inch size or less may be supported by one-hole conduit straps on concrete, tile or steel work, but for larger size conduit, use 2-hole straps. Use clamps of galvanized malleable iron for rigid galvanized conduit and PVC-coated or stainless steel for PVC-coated conduit. Metal framing channel straps used for PVC-coated conduit shall be Type 316 stainless steel
- UU. Install conduits supported from building walls with at least 1/4-inch clearance from the wall to prevent the accumulation of dirt and moisture behind conduit. All conduits shall be routed below concrete floor slabs on grade and shall have sand fill and cover. Set depth to account for radius of turn-up to prevent exposure of elbow bend
- VV. Where specifically shown on plans, size and space embedded conduits in structural slabs in accordance with the Uniform Building Code. Conduits should occupy no more than one-third the thickness of the slab and should not be closer than 3 times the largest diameter on center without additional reinforcement

- WW. Do not cut paved driveways, sidewalks, concrete foundations, etc. to install conduits unless specifically noted on plans. Bore under such construction and maintain a minimum of 24 inches below underside of paving or concrete. Repair any cutting or damage to original condition and to satisfaction of Engineer and Owner
- XX. All conduits for fiber optic cables are to have wide tube radius compatible with cable manufacturer's requirements
- YY. Damaged conduits shall be replaced at no additional cost to Owner where Engineer deems necessary because of extent of damage or, where conductors are damaged by defective conduit installation
- ZZ. Seal all conduits entering motor control centers, control panels, equipment, enclosures, valve actuators, etc. with CSBE seals or, install EYS at locations permissible. Sealing glands shall be selected specifically for each conduit and conductor. Install seals at all equipment located at elevation lower than U.G. conduit route
- AAA. Conduits penetrating underground pull boxes shall be sealed with CSBE seals where larger than 1 ¼-inch diameter and with RTV silicon-based sealant where smaller than 1 ¼-inch diameter
- BBB. Conduits penetrating structural walls of lower levels shall be sealed with CSBE seals where larger than 1 ¼-inch diameter and with RTV silicon-based sealant where smaller than 1 ¼-inch diameter
- CCC. All conduit duct banks penetrating lower level structures and penetrating underground pull boxes shall be sealed watertight between conduit and wall of structure or pull box
- DDD. Where conduits are stubbed out from building for future use, extend conduits 5 feet past building wall or past edge of pavement, whichever is applicable. Do not leave under pavement. Cap ends of conduits
- EEE. All conduits shown entering outside walls of buildings shall stub-up immediately adjacent to wall and penetrate low on wall. Where not shown entering wall, all conduits shall be routed up through building floor by excavating below foundation, core drill through floor, and stub-up conduits then backfill with cement stabilized sand, compacted in place
- FFF. Apply a conductive coating to field-cut threads of aluminum conduits to ensure continuity and ease of joining. Noalox and Kopr-Shield are acceptable coatings
- GGG. Avoid excessive force when tightening threaded fittings for aluminum conduit, both between conduits and at threaded box entries. Generally, the correct force is hand-tight plus one full turn with a wrench. At least three (3) full threads should be engaged
- HHH. Do not use conduit bushings to secure threaded aluminum RMC to a box or enclosure. Install a locknut between a conduit bushing and the inside of the box or enclosure

- III. Threadless fittings shall not be used with threaded aluminum conduit
- JJJ. Install expansion fittings in outdoor runs of aluminum RMC
- KKK. Do not install aluminum conduit in concrete or underground
- LLL. Use special tools for installing aluminum conduit. All damaged conduits shall be replaced
- MMM. In chemical rooms, enclosures, and portable/prefab buildings used for chemical storage or chemical equipment operation, use Schedule 80 PVC conduit and fittings only, except where specifically noted on Plans, use PVC coated steel conduit. Use PVC boxes and enclosures. There are no exceptions to this requirement unless specifically noted on drawings as an exception to this section
- NNN. Do not route conduit on outside walls of buildings or structures unless specifically shown on Plans, route from floor slab. Do not route conduit on building interiors, MCC rooms or equipment rooms unless shown on Plans, or approved in writing. Exception: conduits to light fixtures on ceilings. Paint to match. Where shown on Plans or where approved, conduits shall be painted to match surface on which installed. Submit drawings or sketches of any conduit routing that varies from Plans or Specifications.
- OOO. Where underground conduit ductbanks are routed under new building slabs greater than 4 inches thick, conduits may be encased in cement stabilized sand with red marking tape
- PPP. Provide steel conduit for all security, fire, TV, and access control system circuits. Coordinate circuits and conduit requirements within respective vendors
- QQQ. Paint all exposed conduit threads to prevent corrosion. Match color of conduit
- RRR. Paint all exposed rigid steel surface mounted conduits in MCC rooms. Match wall and ceiling color
- SSS. Where RGS conduit is installed on interior or exterior building walls (or ceilings), paint conduit, supports and clamps to match wall color
- TTT. Contact Engineer for inspection of conduit stub-ups and U.G. ductbanks before concrete pour
- UUU. Where RGS conduit is installed on interior or exterior building walls (or ceilings), paint conduit, supports and clamps to match wall color
- VVV. For conduits that will contain coaxial cable or other wide radius band cables, provide wide sweep conduit elbows on bands that will accommodate pulling such cables thru 3 90 degree turns without exceeding band radius limitations.

END OF SECTION

Section 16133 Underground Ductbank

PART I: GENERAL

1.1 summary

- A. This specification is confidentially issued for this specific project only.
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid.

1.2 references

- A. National Fire Protection Association (NFPA): No. 70 - National Electrical Code (NEC) Appendix B

1.3 Submittals, record drawings, and o&M manuals

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

PART II: PRODUCTS

2.1 acceptable manufacturer's

- A. Thomas and Betts
- B. Underground Devices Inc.
- C. Walker Division, Butler Manufacturing Company.
- D. Carlon
- E. Or approved equal

2.2 materials and equipment

- A. Conduit: Construct ducts using schedule 80 rigid PVC conduit
- B. Spacers: Secure conduit with non-magnetic, universal, interlocking-type spacers for both horizontal and vertical duct arrangements
- C. Concrete: Use steel reinforced, red concrete as duct encasement. Provide Class F concrete in non-truck traffic areas. Provide Class C concrete under gravel or asphalt driveways subject to heavy traffic
- D. Where unprotected service conductors are routed through a pull box with other conductors a divider wall shall be provided in the pull box for separation as required by the NEC

PART III: EXECUTION

3.1 PREPERATION

- A. Have duct spacers and associated hardware packed and crated to avoid damage during shipment and handling
- B. Clearly mark packages or crates stating that the material is for electrical duct banks only
- C. Verify from Drawings and field survey that the location of ductbanks does not interfere with any existing or new underground facilities
- D. Verify that materials are on site in proper condition and that sufficient quantity is on hand for the work
- E. Verify that trenches are in the correct places and prepared with sufficient depth and width to accommodate the duct banks, reinforcing rod, and concrete
- F. Be prepared for inspection of the duct banks before reinforcing rod is installed
- G. Before pouring concrete, verify that the ducts are free of debris and properly installed in the support and spacer systems and that the ducts are properly fitted together and firmly held in place by the hold down hardware
- H. Provide 24-hour notice to Engineer and the Local Code Inspector for cover-up inspection before pouring electrical conduit ductbanks

3.2 INSTALLATION

- A. Conduit runs installed below-grade in earth shall be Sch 80 PVC. Use manufacturer's approved cement for joining couplings and adapters. Runs shall be installed so that top of concrete ductbank is a MINIMUM OF TWENTYFOUR (24") INCHES BELOW FINISHED GRADE. Support conduit runs on plastic spacers and encase conduits with 3000 PSI reinforced concrete dyed with red concrete dye at a rate of 12 pounds of dye per cubic yard of concrete. Provide clearances as shown on detail drawings. Cover top of concrete to finished grade with selected soil that is free from clods, debris, rocks and the like. Pneumatically tamp backfill in six (6") inches to eight (8") inches below finished grade, install continuous run of "BURIED ELECTRIC" marking tape and complete backfill to finished grade. Contractor's means and methods shall prevent floating of conduit and rebar during concrete placement. Metal to metal contact between the earth and rebar cage is not allowed

3.3 EXCAVATION AND BACKFILLING

- A. Do all excavating and backfilling necessary for the installation of the work.

- This shall include shoring and pumping in ditches to keep them dry until the work in question has been installed. All shoring required to protect the excavation and safeguard employees shall be properly performed
- B. All excavations shall be made to the proper depth, with allowances made for floors, forms, beams, piping, finished grades, etc. Ground under conduits shall be well compacted before conduits are installed
 - C. All backfilling shall be made with selected soil; free of rock and debris and shall be pneumatically tamped in six (6") inch layers to secure a field density ratio of 90%
 - D. All excavated material not suitable and not used in the backfill shall be removed offsite at the Contractors expense
 - E. Field check and verify the locations of all underground utilities prior to any excavating. Avoid disturbing these as far as possible. In the event existing utilities are broken into or damaged, they shall be repaired so as to make their operation equal to that before the trenching was started at no additional cost to owner
 - F. Where the excavation requires the opening of existing walks, drives, or other existing pavement, these facilities shall be cut as required to install new lines and to make connections to existing lines. The sizes of the cut shall be held to a minimum consistent with the work to be installed. After installation of new work is completed and the excavation has been backfilled in accordance with above, repair existing walks, drives or other existing pavement to match existing installation
 - G. Use the size and types of conduit as indicated on the Drawings for the various duct banks required for the project
 - H. Make duct bank installations and penetrations through foundation walls watertight
 - I. Assemble ductbanks using non-magnetic saddles, spacers, and separators. Position separators to provide 3-inch minimum concrete separation between the outer surfaces of the conduits
 - J. Provide a 3-inch minimum concrete covering on both sides, top and bottom of concrete envelopes around conduits. Add red dye at the rate of 10 pounds per cubic yard to concrete used for envelopes for easy identification during subsequent excavation
 - K. Firmly fix ducts in place during pouring of concrete. Carefully spade and vibrate the concrete to ensure filling of spaces between ducts
 - L. Make bends with sweeps of radius not less than 6 times the smallest diameter of the raceway
 - M. Make a transition from non-metallic to metallic rigid conduit where duct banks enter structures or turn upward for continuation above grade
 - N. Make bends of 30 degrees or more using rigid galvanized steel

- O. Reinforce duct banks throughout, where indicated on the Drawings
 - 1. Unless otherwise noted on the Drawings, reinforce with No. 5 longitudinal steel bars placed at each corner and along each face at a maximum parallel spacing of 12 inches on centers, and No. 5 tie-bars transversely placed at 18-inch maximum longitudinal intervals
 - 2. Maintain a maximum clearance of 3 inches from bars to the edge of the concrete encasement
- P. Where ducts enter structures such as handholes, manholes, pull boxes, or buildings, terminate the ducts in suitable end bells, insulated L-bushings, Myers hubs or couplings on steel conduits. Tag conduit entering pull boxes with stamped, stainless steel tags. Identify as designated in cable and conduit schedule
- Q. 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 prevent adequate compaction of fill
- R. Install a bare stranded copper duct bank ground on top of duct bank. Make ground electrically continuous throughout the entire duct bank system. Connect ground to switchgear and MCC ground buses and to steel conduit extensions of the underground duct system
- S. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately one-fourth inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to remove any particles of earth, sand or gravel that may have been left in the duct. Re-pull the rag or sponge swab until the swab emerges clean
- T. Use hemp rope to pull conductors into PVC conduit. Do not use nylon or wire cable for this purpose
- U. Install a warning ribbon approximately 12 inches below finished grade over underground duct banks.
- V. For manholes and pull boxes below grade, install racks to support cables properly around the perimeter and keep them dry. Arrange cables in orderly fashion and tie to racks. If metallic racks are used, provide grounding per NEC
- W. For manholes and pull boxes below grade, construct a french drain, or other drainage as detailed on the Drawings
- X. All manhole and U.G. pull boxes used for electrical construction are to have the work "Electrical" permanently embossed on cover
- Y. Conduits penetrating underground pull boxes shall be sealed with CSBE seals where larger than 1 ¼-inch diameter and with RTV silicon-based sealant where smaller than 1 ½-inch diameter

- Z. Conduits penetrating structural walls of lower levels shall be sealed with CSBE seals where larger than 1 ¼-inch diameter and with RTV silicon-based sealant where smaller than 1 ½-inch diameter
- AA. All conduit duct banks penetrating lower level structures and penetrating underground pull boxes shall be sealed watertight between conduit and wall of structure or pull box
- BB. Install identification tags on all conduits at manholes, pull boxes, and junction boxes
- CC. Conduits shall be separated by means of manufactured interlocking “chairs” spaced at no more than 5 feet apart along the length of the ductbank. Spacing between conduits shall not be less than 3 inches
- DD. Every effort shall be made to minimize the number of bends in all ductbank systems. Field bends shall be made using a “hot box” designed for the size of PVC used. Care shall be given to ductbank routing so that very large radius sweeping turns are designed into the route as opposed to factory made 45° and 90° bends. When factory 90° bends are used, they shall be a minimum of 36-inch radius for 4 inch and 48-inch radius for 5 inches. Factory 90° bends used in ductbank construction shall be rigid metal conduit (ferrous) only. These factory-made bends shall be protected by corrosion tape such as 3M Scotchrap 50 or approved equal prior to the concrete pour
- EE. The ductbank support “chairs” shall be spaced up from the bottom of the trench using cement brick to ensure that the proper amount of concrete is poured under the conduits. Sides of the trench may be used as the form if the width does not exceed 1 ½ times the recommended dimension of the ductbank (width.)
- FF. The Electrician shall vacuum, swab, and install pull strings in every conduit of the completed ductbank. The pull string shall be permanently marked in 1-foot increments to aid in wire estimation on future projects. Use Greenlee #435 pull string or approved equal
- GG. Route all electrical ductbanks and conduits below water lines. Maintain minimum of 24 inches between bottom of water line and top of ductbank
- HH. Electrical ductbanks are not required below concrete floors of buildings or below process equipment slabs, at which locations conduits shall be encased in minimum 3 inches of stabilized sand. Where ductbanks are shown on plans to be routed under existing concrete slabs or pavements, install per plan details. Do not cut rebar in existing conduit except where approved by Engineer. Repair any cut or damaged rebar by welding back together after conduits are installed. Submit detail of intent for cutting or removal of existing concrete for ductbank installation to Engineer for approval

END OF SECTION

Section 16211 Electrical Utility Service

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. Electric Utility Charges: Electric Utility charges for extension of distribution system to point of service termination and meters will be paid by Owner, except where bid allowance is indicated, or where specifically noted otherwise on plans or in other specifications
- D. Temporary service disconnects at existing installations shall be paid for by Contractor. Prompt connection or reconnection of service shall be coordinated by Contractor. All temporary disconnection and reconnection costs are to be paid for by Contractor
- E. Determine the exact requirements for the utility service connections and metering facilities as set forth by the utilities that will serve the project, and pay for and perform all work as required by those utilities

1.2 PRICE AND PAYMENT PROCEDURES

- F. The Contractor shall request and pay for the service installation as part of this Contract and maintain the electrical service until the facility is fully installed and accepted by the Engineer and Owner
- G. Allowance may be shown on bid sheet. Where not shown, contractor shall include all costs required for new service or modification to existing service

1.3 REFERENCES

- H. National Fire Protection Association (NFPA): NFPA No. 7093 National Electrical Code (NEC)
- I. Installation shall strictly comply with current Power Company standards. Where plans conflict with Power Company standards, contact Engineer for directions before starting work. Failure to do so is at Contractor's risk

1.4 ADMINISTRATIVE REQUIREMENTS

- J. The Contractor shall be required to transfer ownership of the electric service to the Owner. Documentation of the transfer of ownership shall be submitted to the Owner prior to Contract Closeout. Final payment will not be released until transfer of ownership documents have been submitted to the Owner

PART II: PRODUCTS

2.1 ELECTRIC SERVICE

A. Electric Service Characteristics:

1. As indicated on Drawings and provided by Electric Utility. Standard voltage is as follows:
 - a. 480/277-volt, 3 phase, 4 wire
 - b. 120/240-volt, 3 phase 4 wire
 - c. 120/240-volt, single phase, 3 wire
 - d. Or as shown otherwise
2. Where 480-volt delta service is specifically shown on plans, adjust electrical wiring and select all devices to accommodate that type service. Where 12,470-volt primary service is provided, select all devices to accommodate that type service
3. All 480/277-volt service 200 amps and under, where the service conductors' feeds through the meter shall have a disconnect switch installed upstream of the meter per Power Company standards. This requirement is essential and may be shown on plans. CT cans are required for service above 200 amp
4. Allow for aerial or underground service equipment in bid as determined by Power Company. Most stringent requirements shall be provided at no additional cost to Owner
5. Do not route aerial service drop across site. Contact Engineer if problem.

B. Service Pole Location: Locate service pole based on "Outlet Location Data Statement" and drawing from Power Company. Do not install service pole or service equipment without this data statement and without confirming location with Power Company and Engineer. Contact Engineer prior to construction. Provide submittal with layout of Power Company's pole, Owner's service pole or rack, control panel or MCC or control building for review by owner, Engineer and Power Company before starting construction. Send copy of Power Company "Outlet Location Data Statement" to Engineer for review. Any construction performed without Engineer's review is at Contractor's risk and expense

C. All bus weatherhead installations shall have approved insulated split closure plate around entering conductors from Power Company drop to prevent entry of birds or animals into bus weather head assembly. Install EYS seals in conduits from weather head above to equipment below.

- D. Provide pad mounted transformer service equipment, conduits and devices where only U.G. or pad mounted transformer service is available from Power Company

PART III: EXECUTION

3.1 PREPERATION

- A. Confirmation of Electric Service:
 - 1. Consult with Electric Utility to verify service information specified and shown on Drawings. Failure to do so may result in removal and replacement of service equipment at Contractor's cost. Do not start service installation work until "Outlet Location Data Statement" has been received from Power Company and has been reviewed and approved in writing by the Engineer
- B. Include deviations required by Electric Utility from contract documents to comply with Electric Utility standards and requirements. Send drawing of final service arrangement for engineer's review. Do not install service equipment until approved by Power Company in writing
- C. Relocate service pole, transformer pad or structure up to (10) ten feet to maintain clearance required by Electric Utility Company or to maintain other clearances. Coordinate exact point of service with Power Company and locate customer service pole within distance of Power Company pole as per Power Company Standards. Failure to coordinate location is at expense of Contractor and at no additional cost to Owner
- D. Metering:
 - 1. Consult with Electric Utility regarding service entrance requirements and metering equipment. Conform strictly to Utility Company standards
 - 2. Install metering equipment and empty conduit for metering conductors to meet standards and requirements of Electric Utility
 - 3. Consult with electric utility regarding arrangement of disconnect switch in relation to meter, meter can, or other service equipment
 - 4. Where 480 voltmeters is used and a manual transfer switch is used, install one (1) disconnect switch above meter and one (1) below meter per Power Company requirements
- E. Application for Electric Service.
 - 1. Obtain required forms from Electric Utility.
 - 2. Assist Owner in completion of forms and deliver completed forms to Electric Utility. Advise Owner of exact voltage and phase requirements
 - 3. Coordinate schedule for installation of electric service with Electric Utility.

4. Notify utility company in writing, within 30 days of project start date that permanent service will be required for this project. Specify date required and location of project
5. Notify Owner and Engineer, in writing of date service applied for, date to be installed, Power Company contact name and telephone number and copy of "Outlet Location Data" report as this information become available. Do not start construction of service without this report and without confirming service location with Engineer
6. Notify Power Company when old abandoned service is to be disconnected. Coordinate with Owner
7. Contractor is responsible to see that service is connected according to the Power Company standards. Final permanent service connection by Power Company is required before project is considered complete, before final acceptance, and before final payment is made

END OF SECTION

Section 16212

Short Circuit Coordination Study – Arc Flash Hazard Analysis

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer or an approved engineering firm
- D. The 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 NFPA70E-2004, Annex D
- E. The scope of the studies shall include all new distribution equipment supplied by the equipment Manufacturer under this contract

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 141 – Recommended Practice for Electrical Power Distribution and Coordination of Industrial and Commercial Power Systems
 - 2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
 - 4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
 - 5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
 - 6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations
- B. American National Standards Institute (ANSI):
 - 1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
 - 2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - 3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

4. ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories
 - C. The National Fire Protection Association (NFPA)
 1. NFPA 70 – National Electrical Code, latest edition
 2. NFPA 70E – Standard for Electrical Safety in the Workplace
- 1.3 SUBMITTALS
- A. Refer to specification for Basic Submittal and O&M Requirements 16051
 - B. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. 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
 - C. 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 copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies of the short-circuit input and output data, where required, shall be provided on CD in PDF format
 - D. The report shall include the following sections:
 1. Executive Summary
 2. Descriptions, purpose, basis and scope of the study
 3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties
 4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection
 5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout
 6. Details of the incident energy and flash protection boundary calculations
 7. Recommendations for system improvements, where needed
 8. One-line diagram
 - E. Arc flash labels shall be provided in hard copy only at least 30 days prior to energizing the electrical equipment

PART II: PRODUCTS

2.1 STUDIES

- A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer or an approved engineering firm
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E – Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D

2.2 COMPUTER ANALYSIS SOFTWARE

- A. The studies shall be performed using the latest revision of the SKM Systems Analysis Power* Tools for Windows (PTW) software program

2.3 DATA COLLECTION

- A. 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. The 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.
- B. Source combination may include present and future motors and generators
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor
- 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

2.4 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances base 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. Unit substation primary and secondary terminals
 - 4. Low voltage switchgear
 - 5. Motor control centers
 - 6. Standby generators and automatic transfer switches
 - 7. Branch circuit panelboards
 - 8. 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 Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current

2.5 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 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

2.6 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-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, panelboards, busway and splitters) where work could be performed on energized parts
- C. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA 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 1.2 cal/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 calculation 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 lines 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 calculation 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 2 seconds based on IEEE 1584-2018 section B.1.2. Where it is not physically possible to move outside the flash protections boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized

2.7 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
 - i. Based on fault point X/R ratio
 - ii. Based on calculated symmetrical value multiplied by 1.6
 - iii. 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 III: EXECUTION

3.1 QUALIFIED ELECTRICAL CONTRACTORS

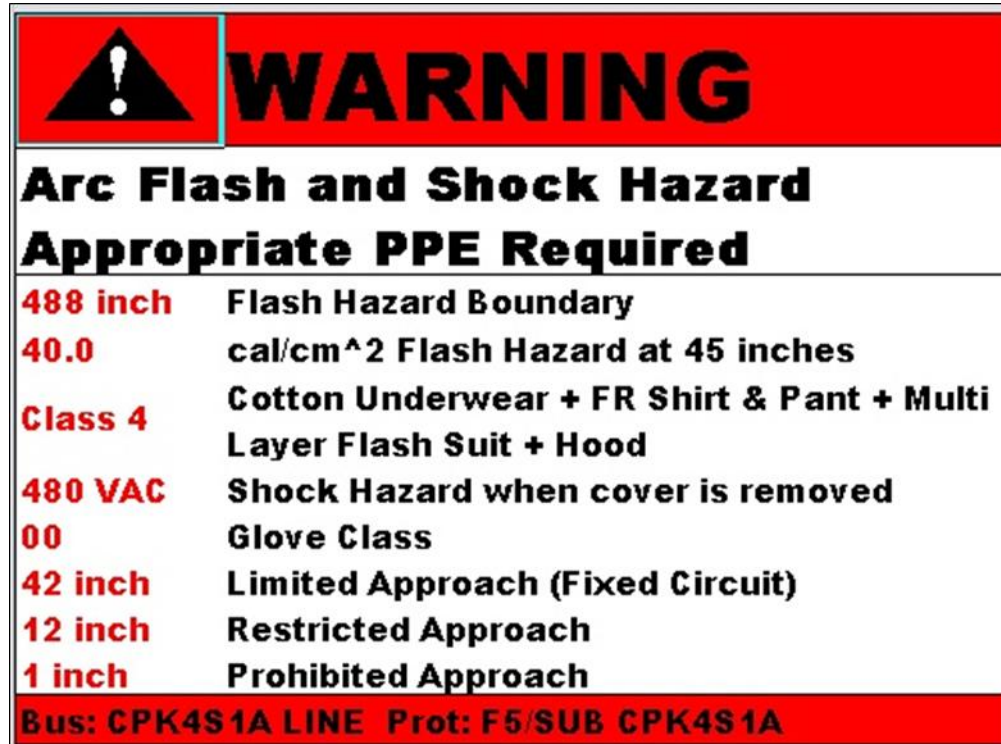
- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies
- B. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm
- C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies
- D. 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

3.2 ARC FLASH WARNING LABELS

- A. The contractor of the Arc Flash Hazard Analysis shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed

- 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 owner and after any system changes, upgrades or modifications have been incorporated in the system
- C. The label shall include the following information, at a minimum:
 - 1. Location designation
 - 2. Nominal voltage
 - 3. Flash protection boundary
 - 4. Hazard risk category
 - 5. Incident energy
 - 6. Working distance
 - 7. Engineering report number, revision number and issue date
- D. Labels shall be machine printed, with no field markings
- E. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings
 - 1. For each 480 and applicable 208-volt panelboard, one arc flash label shall be provided
 - 2. For each motor control center, one arc flash label shall be provided
 - 3. For each low voltage switchboard, one arc flash label shall be provided
 - 4. For each switchgear, one flash label shall be provided
 - 5. For medium voltage switches one arc flash label shall be provided.
- F. Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion

- G. Example of Arc Flash Warning Label:



3.3 ADJUSTEMENT/CALIBRATION

- 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 engineering service division of the 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 Owner in writing of any required major equipment modifications

3.4 TRAINING

- A. The contractor of the Arc Flash Hazard Analysis shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum 4 hours). The training shall be certified for continuing education units (CEU's) by the International Association for Continuing Education Training (IACET) or equivalent

END OF SECTION

Section 16261 Automatic Transfer Switch

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. Contractor shall contact local Factory Representative to verify all equipment purchased conforms to the requirements of this project. Failure to do so may result in equipment removal and replacement at Contractor's expense
- D. Under no conditions shall transfer switch ampacity be rated less than main service breaker ampacity
- E. Transfer switches with cable linkage when in manual mode are not accepted. Coordinate power and controls with Generator Manufacturer where generator is shown on Plans
- F. All equipment, instruments and devices provided for this project shall have means of protection from power line conditions such as surge, phase fail, or other line conditions that may damage equipment, instruments or devices furnished. It is vendors and manufacturers' responsibility to provide protective devices as required for maintaining warranty of furnished items and to assure no damage occurs from power line conditions

1.2 SCOPE OF WORK

- A. An automatic transfer switch shall be installed and rated at 480 Volts and 60 HZ and be mechanically held and electrically operated by a single solenoid mechanism energized from the source to which the load is to be transferred and capable of manual operation by one person. The switch shall be mechanically and electrically interlocked to ensure one of the two positions - normal or emergency. The switch shall be applicable to 50 Hz or 60 Hz and suitable for all common voltages from 110 to 600. Switch shall be service entrance rated and housed in a NEMA 1 Gasketed steel enclosure and shall conform with the provisions of underwriter's Laboratories 1008 Standards and meet the National Electric Code (NEC) requirements for critical applications.
- B. Accessories- Transfer switches shall be equipped with the following accessories:
- C. Time delay to retransfer to normal power source: Time delay to be provided for retransfer from emergency power to normal power (if restored and within acceptable operating parameters). This time delay is to be

automatically bypassed in the event the emergency source fails and normal power is available. Retransfer time delay to be field adjustable from 0-30 minutes.

- D. Unit to be shipped with the initial transfer to normal power source time delay set at 5 minutes.
- E. Time delay on engine cooling, (fixed, non-adjustable 5 minutes, -1 to +2 minutes tolerance)
- F. Time delay on engine starting, (adjustable 0.5 to 60 seconds)
- G. A test switch to simulate a normal power source failure
- H. Pilot contact to initiate engine starting control.
- I. Pilot lights to visually indicate the transfer switch position
- J. Relay contacts as required plus one spare set of normally open and normally closed relay contacts
- K. Provide solid state exerciser clock to set the day, time, and duration of generator set exercise/test period. Provide a with/without load selector switch for the exercise period.

1.3 REFERENCES

- A. National Fire Protection Association (NFPA): NFPA 70 - National Electrical Code (NEC)
- B. National Electrical Manufacturers Association (NEMA): NEMA ICS 2-447-AC Automatic Transfer Switches
- C. Underwriters Laboratories (UL): UL 1008 - Standard for Automatic Transfer Switches

1.4 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051
- B. Submit all products covered under this specification for engineer's approval. Contractor shall submit transfer switch data to power company for approval prior to submitting to engineer
- C. Manufacturer shall submit shop drawings for review, which shall include the following, as a minimum:
 - 1. Descriptive literature
 - 2. Plan, elevation, side, and front view arrangement drawings, including overall dimension, weights and clearances, as well as mounting or anchoring requirements and conduit entrance locations.
 - 3. Installation exhibit showing dimension and spacing between existing equipment
 - 4. Schematic diagrams
 - 5. Wiring diagrams

6. Accessory list
7. Training outline
8. Manufacturers testing reports as requested

PART II: PRODUCTS

2.1 manufacturer's

- A. ASCO
- B. Cummins
- C. Eaton
- D. Five Star Electric
- E. Lexington Zenith
- F. Russelectric
- G. Generator manufacturer provided ATS, or equal, as pre-approved in writing. No substitutions allowed except where pre-approved in writing by Engineer
- H. Listing of acceptable Manufacturers does not relieve obligation of conditions described in this Specification Section

2.2 CONSTRUCTION

- A. General:
 1. The delayed transition automatic transfer switch shall be furnished as shown on the drawings. Voltage and continuous current ratings and number of poles shall be as shown. Switches shall be UL listed in accordance with UL-1008
 2. Where transfer switch is shown on one-line diagram or on details as installed directly after service head and, where no overcurrent protection precedes the transfer switch, a service rated, breaker type switch shall be provided
 3. Ampacity of transfer switch contacts shall be rated equal or greater than ampacity of main service breaker. No exceptions
 4. On 3 phase, 4 wire systems, utilizing ground fault protection downstream of the transfer switch, a true 4-pole switch shall be supplied with all four poles mounted on a common shaft. The continuous current rating and the closing and withstand rating of the fourth pole shall be identical to the rating of the main poles and shall have quick-break contacts. See plans for 4 pole requirements. This requirement does not apply for water and wastewater facility installation
 5. The transfer switch shall be mounted in a NEMA 4X 316 S.S. for outdoors, unless otherwise indicated. Indoor enclosures shall be

fabricated from 12-gauge steel. The enclosure shall be sized to exceed minimum wire bending space required by UL 1008. Outdoor enclosures shall have no exposed controls. Fabricated covers over exposed controls are not allowed. Controls shall be located on inner door of automatic transfer switch. Enclosure shall have three (3) point latching handle with locking hasp. Where shown on plans in MCC, transfer switch enclosure shall match MCC enclosure

6. The transfer switch shall be equipped with an internal welded steel pocket, housing an operations and maintenance manual
7. The transfer switch shall be top and bottom accessible
8. The main contacts shall be capable of being replaced without removing the main power cables, or removing incoming normal power from service rated transfer switches
9. The main contacts shall be visible for inspection without any major disassembly of the transfer switch
10. All bolted bus connections shall have Belleville compression type washers
11. When a solid neutral is required, a fully rated bus bar with required AL-CU neutral lugs shall be provided. All grounding and neutral conductors shall be terminated and labeled per article 250 of latest edition of National Electrical Code
12. Control components and wiring shall be front accessible. All control wires shall be multi-conductor 18-gauge 600-volt SIS switchboard type point-to-point harness. All control wire terminations shall be identified with tubular sleeve-type markers
13. The switch shall be equipped with 90 degrees C rated copper/aluminum solderless mechanical type lugs
14. The complete transfer switch assembly shall be factory tested to ensure proper operation and compliance with the specification requirements. A copy of the factory test report shall be available to engineer with ATS submittal upon request
15. Transfer time shall be of sufficient duration to allow motor run controls to drop out or, Contractor shall provide additional time delay controls in the neutral position, both directions of transfer to accomplish this function
16. Provide 480: 120/240-volt, single phase transformer and all required circuit breakers to provide low voltage power to all generator heaters, controls, etc. Feed from load motor control center or, from side of ATS where shown on plans
17. All power and control circuits to have circuit breakers for overcurrent protection. Fuses are not acceptable. No Exceptions

18. All doors on outdoor enclosures shall have door restraints, 3-point latching handle and locking hasp. Keyed handles are not acceptable
19. No devices or controls are to be installed on outer door of outdoor enclosures or where NEMA 4X rated
20. Provide generator status annunciator with voltage, current, and phase indicators and run time (non-resettable) elapse time meter in panel (door) of indoor transfer switch. Provide nameplate. Flush mount annunciator. Where ATS is located outdoors or in NEMA 4 X enclosure, mount status annunciator in inner door panel. Installation to be completed by ATS Factory Technician
21. Install Generator Manufacturer furnished alarm annunciator panel on wall near ATS or as shown on plans
22. All circuit breakers shall be covered. No exposed circuit breakers. No exceptions
23. Provide heater with thermostat control in all enclosures. Route 120 VAC circuit from LVP. Provide circuit breaker
24. Provide all power supplies required to operate transfer switch
25. Where transfer switch contains two circuit breakers, and where service breaker serves as main breaker, the transfer switch shall be UL listed, "Service Rated," and acceptable to Power Company

B. Automatic Transfer Switch:

1. The transfer switch shall be double throw, actuated by two electric operators momentarily energized, and connected to the transfer mechanism by a simple over center type linkage. Cable linkage mechanism is not acceptable
2. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in both the normal and emergency positions without the use of hooks, latches, magnets, or springs, and shall be silver-tungsten alloy. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches. Interlocked, molded case circuit breakers or contactors are not acceptable unless specifically shown on Plans, or pre-approved in writing
3. The transfer switch shall be equipped with a safe external manual operator, designed to prevent injury to operating personnel. The manual operator shall be front accessible and shall provide "quick make-quick break" operation, offering the same contact-to-contact transfer speed as the electrical operator to prevent switching the main contacts slowly. The external manual operator shall be UL listed for operation, under load, from the outside of the transfer switch while the door is closed. Door shall have 3-point latching handle. No automatic

transfer switch enclosure shall be installed without door; Exerciser timer shall be readily accessible to operator

4. Circuit breakers used for service rated transfer switches shall be mechanically or electrically interlocked in a manner acceptable to the local Power Company
5. Provide all AC and/or DC power supplies required for transfer switch operation. Provide separate batteries and charger where operation requires separate power source independent of normal or generator power sources

C. Automatic Transfer Switch Controls:

1. The transfer switch shall be equipped with a microprocessor-based control system, to provide all the operational functions of the automatic transfer switch. The controller shall have two asynchronous serial ports. The controller shall have a real-time clock with battery backup
2. The CPU shall be equipped with self-diagnostics, which perform periodic checks of the memory I/O, and communication circuits, with a watchdog/power fail circuit
3. The controller shall have industry standard ethernet port connections for communicating with future industrial control system controller via a ethernet data switch
4. The Ethernet communication port shall allow interface to the Manufacturers and/or the Owner's furnished remote supervisory control. Provide all software, programming, testing, and cables and hardware for a complete operating system. Coordinate with SCADA Provider and Programmer and assist in setting up system. Provide all addresses, HMI templates, and function descriptions for Programmer's use. Functions shall include status of all operating time settings such as transfer time, transition delays, etc.
5. The controller shall have password protection required to limit access to qualified and authorized personnel
6. The controller shall include human machine interface with keypad allowing access to the system for generator exercising and time delay modifications
7. The controller shall include three phase over/under voltage, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources
8. The controller shall store the following records in memory for access either locally or remotely:

Number of hours transfer switch is in the emergency position

Number of hours emergency power is available

Total transfer in either direction

Date, time, and description of the last four source failures
Date of the last exercise period
Date of record reset (where applicable)

D. Sequence of Operation:

1. When the voltage on any phase of the normal source drops below 80% or increases to 120%, or frequency drops below 90%, or increase to 110%, or 20% voltage differential between phases occurs, after a programmable time delay period of 0-300 seconds factory set at 3 seconds to allow for momentary dips, the engine starting contacts shall close to start the generating plant
2. The transfer switch shall transfer to emergency when the generating plant has reached specified voltage and frequency on all phases
3. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-3600 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source
4. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-3600 seconds, factory set at 300 seconds

E. Automatic Transfer Switch Accessories:

1. Programmable three phase sensing of the normal source set to pick up at 90% and dropout at 80% of rated voltage and overvoltage to pick up at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pick up at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring
2. Time delay for override of momentary normal source power outages (delays engine start signals and transfer switch operation). Programmable 0-300 seconds. Factory set at 3 seconds, if not otherwise specified
3. Time delay to control contact transition time on transfer to either source. Programmable 0-120 seconds, factory set at 10 seconds
4. Time delay on retransfer to normal, programmable 0-3600 seconds, factory set at 300 seconds if not otherwise specified, with overrun to provide programmable 03600 second time delay, factory set at 300 seconds, unloaded engine operation after retransfer to normal. Time delay in neutral position of switch shall be adjustable 0-300 seconds
5. Time delay on transfer to emergency, programmable 0-300 seconds,

factory set at 1 second.

6. A maintained type load test switch shall be included to simulate a normal power failure, keypad initiated.
7. A remote type load test switch shall be included to simulate a normal power failure, remote switch initiated.
8. A time delay bypass on retransfer to normal shall be included. Keypad initiated.
9. Contact rated 10 Amps 30 volts DC, to close on failure of normal source to initiate engine starting.
10. Contact rated 10 Amps 30 volts DC, to open on failure of normal source for customer functions
11. Light emitting diodes shall be mounted on the microprocessor panel to indicate switch is in normal position, switch is in emergency position, and controller is running
12. A plant exerciser shall be provided with ten (10) 7-day events, programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise generating plant programmable in one-minute increments. Also include selection of either "no load" (switch will not transfer) or "load" (switch will transfer) exercise period. Keypad initiated with password. Provide means to observe and adjust settings locally and via data link to plant PLC controller
13. Provision to select either "no commit" or "commit" to transfer operation in the event of a normal power failure shall be included. In the "no commit position," the load will transfer to the emergency position unless normal power returns before the emergency source has reach 90% of its rated values (switch will remain in normal). In the "commit position", the load will transfer to the emergency position after any normal power failure. Keypad initiated
14. Two auxiliary contacts rated 10 Amp, 120 volts AC (for switches 100 to 800 amps) 15-amp, 120 volts AC (for switches 1000 to 4000 amps), shall be mounted on the main shaft, one closed on normal, the other closed on emergency. Both contacts will be wired to a terminal strip for ease of customer connections
15. A three-phase voltage readout, with 1% accuracy shall display all three phase-to-phase voltages simultaneously, for both the normal and emergency source
16. A frequency readout with 1% accuracy shall display frequency for both normal and emergency source
17. A readout shall display normal source and emergency source availability

18. Signal before transfer contacts.
19. Selector switch to allow transfer by manual push button or switch movement
20. Maintenance Selector Switch: For service rated transfer switches provide means to deactivate switch in "Normal," "Open," or "Emergency" positions when servicing internal parts of switch assembly. Provide means for locking out in any position
21. Provide means to temporarily switch off "All" control voltages that are tapped on the incoming power side of the Normal circuit break for maintenance purposes. This is to remove all live voltages during service of transfer switches
22. Provide all available "Options" for transfer switch

F. Ratings:

1. Delayed transition automatic transfer switches shall have the following 3-cycle short circuit closing and withstand as follows:

- a. RMS Symmetrical Amperes 480 VAC

<u>Amperes</u>	<u>Closing and Withstand</u>	<u>Current Limiting Fuse Rating</u>
100-400	42,000	200,000
600	50,000	200,000
800	65,000	200,000
1000-1200	85,000	200,000
1600-4000	100,000	200,000

2. During the 3-cycle closing and withstand tests, there shall be no contact welding or damage. The 3-cycle tests shall be performed without the use of current limiting fuses. The test shall verify that contacts separation has not occurred, and there is contact continuity across all phases. Test procedures shall be in accordance with UL-1008, and testing shall be certified by Underwriters' Laboratories, Inc
3. When conducting temperature rise tests to UL-1008, the manufacture shall include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rated current after completing the overload and endurance tests
4. The microprocessor controller shall meet the following requirements:
 - a. Storage conditions - 25 degrees C to 85 degrees C
 - b. Operation conditions - 20 degrees C to 70 degrees C ambient
 - c. Humidity 0 to 99% relative humidity, non-condensing
 - d. Capable of withstanding infinite power interruptions
 - e. Surge withstand per ANSI/IEEE C-37.90A-1978
5. Manufacturer shall provide copies of test reports upon request

- G. Provide means to remotely monitor switch positions via a data network. See electrical plans for additional requirements. Provide all programming, software and devices. Provide on CD all addressing information for starter, alarm, and functions available for display at future PLC HMI. Manufacturer's Representative shall provide setup assistance during construction. Coordinate with Generator and Data Monitoring Systems Vendors to assure a unified power system
- H. Manufacturer:
 - 1. The transfer switch manufacturer shall employ a nationwide factory-direct, field service organization, available on a 24-hour a day, 365 days a year, call basis
 - 2. The Manufacturer shall include an 800-telephone number, for field service contact, affixed to each enclosure
 - 3. The manufacturer shall maintain records of each transfer switch, by serial number, for a minimum 20 years
- I. Warranty: Provide Manufacturer's standard full 5-year comprehensive extended coverage service. Warranty shall be "on site" and warranty service shall be available by the factory service department on an emergency basis if required. Depot or non-site warranties are not acceptable
- J. Load Bank Controls:
 - 1. Where load bank is required, provide all controls, contactors, and devices needed to exercise generator on load bank. Normal plant loads shall not be on generator during load bank operation of generator
 - 2. Coordinate with Generator Vendor
 - 3. Submit load bank controls data
- K. Provide fiber optic connector interface where indicated on plans
- L. Where transfer switches are used ahead of main breaker or include main breaker, unit shall be "service rated" and shall have normal service breaker rated for service ampacity

2.3 PROTECTION

- M. All equipment installed on this project shall incorporate all devices and features to protect that equipment from the influence of other equipment, line voltage and phase irregularities, harmonics and other disturbances that may affect the proper and safe operation of that equipment whether these required features are a standard component of that equipment as an off-the-line product. No equipment shall be installed without these features

PART II: EXECUTION

3.1 INSTALLATION

- A. Automatic Transfer Switches shall be provided with adequate lifting means for ease of installation of wall or floor mounted enclosures
- B. Provide access and working space as indicated or as required per latest edition of National Electrical Code
- C. Where Contractor fails to protect automatic transfer switches before and after installation on site and where excessive dust is observed inside the enclosure, the Contractor shall have a factory warranty service technician clean, inspect and test unit, after which the factory shall issue a written and signed statement that full factory is in effect. There are no exceptions to this requirement except to replace entire unit at Engineer's request

3.2 ADJUSTMENTS

- A. Tighten assembled bolted connections with appropriate tools to manufacturer's torque recommendations prior to first energization

3.3 START-UP AND TESTING

- A. Provide the services of a Factory Technician to checkout, adjust, set-up, test, and start-up the automatic transfer switch in conjunction with the standby generator. Fully function test the automatic transfer switch to verify proper operation
- B. A Factory Technician shall be present for final acceptance testing and shall demonstrate unit operation to Engineer and Owner's Representative
- C. Factory Representative shall demonstrate operation of system to Owner and Engineer
- D. Where items are not functional at time of generator start-up, generator manufacturer shall return for additional start-up and testing as required for a complete and thorough demonstration

3.4 TRAINING

- A. Provide two (2) 4-hour training courses conducted by Manufacturer's Representative at a time approved by Owner and Engineer. Training shall include operation and required owner service and preventative maintenance. Operation and Maintenance Manuals shall be used during training for reference

3.5 WARRANTY

- A. Contractor shall provide the Manufacturer's full 5-year comprehensive extended coverage service warranty on the generator installation and shall include all labor and materials required to repair or replace equipment and/or components that are defective or malfunctioning. Included under this warranty shall be all equipment, devices, hardware, and software

- B. This warranty shall begin on date of written "Final Acceptance" of the electrical systems and to be executed as required at no additional cost to the Owner. Contractor's warranty shall also guarantee 24-hour service response time and shall provide labor, work, or materials as necessary to maintain plant operation when replacement parts are on order. In no case shall plant electrical systems be out of service for more than 24 hours from time Owner calls for warranty service
- C. This shall be provided at no additional cost to the Owner. All equipment and materials installed shall have full warranty from Manufacturer that guarantees equipment is rated for harsh industrial electrical/mechanical environment in which it is installed. Where Manufacturer's products fail prematurely, Manufacturer shall be fully responsible for new replacement and shall not have the option of declaring that failures were caused by environmental conditions and its effect on the product
- D. Contractor is fully responsible for assuring that Product Manufacturers are aware of this condition and that warranty statement is included in shop drawing submittals. Failure to do so will be at the Contractor's expense and at no additional cost to the Owner
- E. All critical warranted repairs shall be made within 24 hours of receipt of required parts from Manufacturer with reasonable delivery time of overnight shipping. Any repairs not completed within 5 working days from date of notice are subject to Owner making other arrangements for repair and back charging Contractor. This requirement is a condition of this contract
- F. Where equipment or instrument problems remain unresolved by Contractor beyond a reasonable time, a Factory Technician shall be provided on-site to take any corrective actions necessary to put equipment or instruments in operating order. Owner and Engineer reserve the right to determine a reasonable time for corrective action by Contractor

END OF SECTION

Section 16410 Enclosed Switches and Circuit Breakers

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. This section covers service disconnects, feeder disconnects, equipment disconnects, and enclosed circuit breakers

1.2 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051
- B. Product Data:
 - 1. Submit for switches, circuit breakers, and accessories
 - 2. Descriptive data and time current curves for protective devices and let through current curves for those devices with current limiting characteristics. Include coordination charts and tables, and related data

1.3 RECORD DRAWINGS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.4 OPERATIONS & MAINTENANCE MANUALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.5 QUALITY ASSURANCE

- A. Coordination: Contractor shall determine size, horsepower, voltage, and phase of all equipment to provide/adjust breaker and fused switch size accordingly. Failure to do so will be at expense of contractor at no additional cost to owner
 - 1.

PART II: PRODUCTS

2.1 MANUFACTURER'S

- B. Fusible Switches:
 - 1. Eaton
 - 2. Or approved equal
- C. Fused Power Circuit Devices:
 - 1. Eaton

- 2. Or approved equal
- D. Boltswitch
- E. Molded Case Circuit Breakers:
 - 1. Eaton
 - 2. Or approved equal
- F. Combination Circuit Breaker and Ground Fault Trip:
 - 1. Eaton
- G. Molded Case Current Limiting Circuit Breakers:
 - 1. Eaton

2.2 ENCLOSED SWITCHES

- H. Enclosed Non-fusible Switch: NEMA KS 1, Type HD handle lockable with 2 padlocks
- I. Enclosed Fusible Switch, 800 Amperes and Smaller: NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with two (2) padlocks, and interlocked with cover in CLOSED position
- J. Enclosed Fusible Switch Larger Than 800 Amperes: Bolted pressure or high-pressure contact switch, bus drilled to accommodate specified fuses, enclosure consistent with environment where located
 - 1. Minimum Fault Current Rating: 100,000 symmetrical rms amperes.
- K. All enclosures located outdoors or where subject to wet or environmentally harsh locations shall be NEMA 4X 316 stainless steel
- L. All switches shall be rated at 600 volts minimum.
- M. Handle operator mechanisms shall be on side of enclosure and not on front. Keyed mechanisms that separate handle from breaker mechanism when door is opened are not acceptable

2.3 ENCLOSED CIRCUIT BREAKERS

- N. Enclosed Molded Case Circuit Breaker: NEMA AB 1, handle lockable with 2 padlocks
- O. Characteristics:
 - 1. Frame size, trip rating, number of poles, and auxiliary devices as indicated
 - 2. Interrupting capacity rating to meet available fault current, 10,000 symmetrical rms amperes minimum
 - 3. Appropriate application listing when used for switching fluorescent lighting loads or heating, air conditioning, and refrigeration equipment
- P. All enclosures located outdoors or where subject to wet or environmentally

harsh locations shall be NEMA 4X 316 stainless steel

2.4 ACCESSORIES

- Q. Solid state breaker requiring programming unit for settings adjustment
 - 1. Provide new programming unit and all accessories for Owner and Engineers use. Turn over to Engineer for review and testing
- R. Original set-up and adjustments shall be performed by the Circuit Breaker Manufacturers Factory Representative

2.5 TRIP UNITS

- S. All service and feeder breakers shall have replaceable trip plugs, adjustable, or electric type with adjustable trips

PART III: EXECUTION

3.1 INSTALLATION

- T. Install enclosed switches and circuit breakers in locations as indicated, according to Manufacturer's written instructions
- U. Install enclosed switches and circuit breakers level and plumb
- V. Install wiring between enclosed switches and circuit breakers and control/indication devices
- W. Connect enclosed switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A

3.2 ADJUSTEMENT/CALIBRATION

- X. Set field adjustable enclosed equipment trip ranges as recommended by manufacturer

END OF SECTION

Section 16415 Surge Suppression

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. This section describes the requirements for low-voltage AC surge protective devices (SPD's) for various service and electrical equipment
- D. All equipment described herein shall be submitted, and factory installed, as an integral part of equipment specified in overall construction documents

1.2 PRICE AND PAYMENT PROCEDURES

- A. No separate payment for work performed under this section. Include cost for surge suppression in overall electrical equipment

1.3 REFERENCES

- A. This specification references the following publications in their current editions. The publications are referred to in the text by basic designation only
 1. DLA MIL-STD-220C: Method of Insertion Loss Measurement
 2. IEEE C37.90.1: Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
 3. IEEE C62.41.2: Recommended Practice on Characterization of Surges in Low Voltage (1,000 V and Less) AC Power Circuits
 4. IEEE C62.45: Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000 V and Less) AC Power Circuits
 5. NFPA 70: National Electrical Code (NEC) - Article 285 UL 67: UL Standard for Safety Panelboards
 6. UL 845: UL Standard for Safety Motor Control Centers UL 891: UL Standard for Safety Switchboards
 7. UL 1283: UL Standard for Safety Electromagnetic Interference Filters
 8. UL 1449: UL Standard for Safety Surge Protective Devices
 9. UL 1558: UL Standard for Safety Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear
 10. UL 67: UL Standard for Safety Panelboards
 11. UL 845: UL Standard for Safety Motor Control Centers

12. UL 891: UL Standard for Safety Switchboards
13. UL 1558: UL Standard for Safety Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear
14. All SPDs and their installation shall comply with the requirements of the National Electric Code and Underwriters Laboratories (UL) where applicable
15. Each specified device shall also conform to the standards and codes listed in overall construction documents
16. Refer to general work and all relevant specifications in construction documents for additional requirements and coordination
17. Refer to submittal requirements in other specifications for full requirements
18. Refer to O&M manual requirements in other specifications for full requirements

1.4 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051
- B. Submit catalog data for all items supplied from this section as applicable. Submittal shall include at minimum:
 1. Cut sheets
 2. Functions
 3. Ratings
 4. Inputs
 5. Outputs
 6. Displays
 7. Dimensional drawings of each SPD type
 8. UL 1449 documentation
 9. Compliance documentation with Nationally Recognized Testing Laboratory (NRTL)
 10. UL 1283 documentation
 11. IEEE C62.41.2 and IEEE C62.45, Category C3 (20kV-1.2/50, 10kA-8/20 μ s waveform) clamping voltage test results
 12. All other information required to confirm SPD conforms to all requirements

1.5 OPERATIONS & MAINTENANCE MANUALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.6 QUALITY ASSURANCE

- A. The manufacturer of this equipment shall have produced similar equipment for a minimum of five (5) years. Engineer may request a list of installations with similar equipment demonstrating qualifications
- B. The manufacturer shall be the same manufacturer providing service entrance and distribution equipment where SPD's are to be installed
- C. Equipment shall comply and be tested under the UL standards stated in reference section of this specification
- D. Manufacturer shall be ISO 9001 or 9002 certified

1.7 SPARE PARTS

- A. Provide one surge protective device per installed equipment on project
 - B. Deliver spare parts to operations and provide signed transmittal form to engineer
 - C. Lack of transmittal form may require providing additional equipment at no additional cost to owner where supply chain is broken
- 1.

PART II: PRODUCTS

2.1 Approved spd Type 1 and type 2 Manufacturer's

- A. Eaton
- B. General Electric
- C. Schneider Electric
- D. Allen Bradley
- E. Citel
- F. Or approved equal

2.2 APPROVED SPD TYPE 3 MANUFACTURER'S

- A. EDCO SLAC Series
- B. Phoenix Contact
- C. Citel
- D. Siemens
- E. Or approved equal

2.3 SERVICE ENTRANCE RATED EQUIPMENT (TYPE 1)

- A. This type applies to switchgear, switchboards, panelboards, motor control centers, and other devices installed as service entrance equipment
- B. Where a type 1 SPD installed on service entrance equipment, an additional

type 2 SPD shall not be installed unless shown on plans

- C. The SPD shall be of the same manufacturer as the electrical equipment installed
- D. The SPD shall be integral to the equipment as a factory standardized design

2.4 DISTRIBUTION EQUIPMENT APPLICATIONS (TYPE 2)

- A. This type applies to switchgear, switchboards, panelboards, motor control centers, and other devices installed as non-service entrance equipment
- B. The SPD shall be of the same manufacturer as the electrical equipment installed
- C. The SPD shall be integral to the equipment as a factory standardized design
- D. The SPD shall be included and mounted within the equipment by the equipment manufacturer
- E. The SPD shall be located within the panelboard, unless otherwise noted in plans

2.5 CONSTRUCTION

- A. Overcurrent Protection: The unit shall contain thermally protected metal-oxide varistors (MOVs). The thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOVs from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
- B. Maintenance Free Design: The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries are not acceptable. SPDs requiring any maintenance of any sort such as periodic tightening of connections are not acceptable.
- C. Balanced Suppression Platform: The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules are not acceptable.
- D. Electrical Noise Filter: Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the DLA MIL-STD-220C insertion loss test method.
- E. Local Monitoring: Visible indication of proper SPD connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each SPD module

shall be monitored on the front cover of the enclosure as well as on the module. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.

- F. Surge Counter: The SPD shall indicate user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of $50 \pm 20A$ occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. To prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total. The ongoing surge count shall be stored in nonvolatile memory or UPS backup.
- G. Remote Monitoring: For remote monitoring, the SPDs shall provide the same discrete and analog signal and control functions as specified for local monitoring and the surge counter, to a terminal strip for outgoing connection to a PLC as shown on the Plans. The functions shall be converted as specified for interface to the monitored equipment.
- H. The voltage surge suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
- I. SPD shall be listed in accordance with UL 1449 and UL 1283
- J. Integrated surge protective devices (SPD) shall be Component Recognized in accordance with UL 1449, Section 37.3.2 and 37.4 at the standard's highest short circuit current rating (SCCR) of 200 kA, including intermediate level of fault current testing.
- K. SPD shall be tested with the ANSI/IEEE Category C High exposure waveform (20kV-1.2/50 μ s, 10kA-8/20 μ s).
- L. SPD shall provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems (7 Mode).

2.6 RATINGS

- A. Unit operating voltage: Refer to plans for operating voltage equipment and unit configuration
- B. SPD shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage measured on site
- C. Minimum surge current rating shall be 240kA per phase (120kA per mode) for service entrance and 120kA per phase (60kA per mode) for distribution applications

- D. Pulse life test: Capable of protecting against and surviving 5000 ANSI/IEEE category C high transients without failure or degradation of clamping voltage by more than 10%
- E. Minimum UL 1449 withstand nominal discharge current (In) rating to be 20kA per mode
- F. UL 1449 clamping voltage must not exceed the following: Voltage Protection Rating (VPR)

<u>Voltage</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>
204/120	1200/800V	800V	800V
208Y/120	800V	800V	800V
480Y/277	1200V	1200V	1200V
600Y/347	1500V	1500V	1500V

PART III: EXECUTION

3.1 INSTALLATION

- A. All equipment specified herein shall be factory installed, field adjusted, tested, and cleaned as an integral part of equipment specified in other equipment specification
- B. Type 1 and 2 SPD's shall be grounded and bonded as a part of the individual equipment as specified in the individual equipment specifications
- C. Type 3 shall be grounded and bonded in accordance with the SPD manufacturer's instructions
- D. All monitoring and diagnostic features shall be visible from the front of the equipment
- E. Provide and install a fully integrated component design: All SPD's components and diagnostics shall be contained within one discrete assembly
- F. SPD's or individual SPD modules that must be ganged together to achieve higher surge current ratings
- G. Furnish nameplates for each SPD as shown on plans

3.2 SERVICE ENTRANCE RATED EQUIPMENT (TYPE 1)

- A. Service entrance located SPD's shall be tested and demonstrate suitability for application within IEEE C26.41.2 category C environments
- B. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bars

- C. The SPD shall be connected through a UL approved disconnecting means. The disconnect shall be located in immediate proximity to the SPD
 - D. Connection shall be made via electrical bus, conductors, or other connections originating in the SPD and shall be kept as short as possible
- 3.3 DISTRIBUTION EQUIPMENT APPLICATIONS (TYPE 2)
- A. Service entrance located SPD's shall be tested and demonstrate suitability for application within IEEE C26.41.2 category B environments
 - B. SPD's shall be installed immediately following the load side of the main breaker
 - C. SPD's installed in main lug only panelboards shall be installed immediately following the incoming main lugs
- 3.4 INDIVIDUAL EQUIPMENT PROTECTION (TYPE 3)
- A. Locate the SPD on the load side of the ground and neutral connections
 - B. The SPD shall be connected through a UL approved disconnecting means. The disconnect shall be located in immediate proximity to the SPD
- 3.5 ADJUSTMENT/CALIBRATION
- A. Coordinate stabilized voltage levels within the project boundaries and provide product voltage rated equipment appropriate to avoid overvoltage
- 3.6 MAINTENANCE/WARRANTY
- A. The manufacturer shall warrant the equipment to be free from defects in material and workmanship for ten (10) years from date of substantial completion
 - B. Within such period of warranty, the manufacturer shall promptly furnish all material and labor necessary to return the equipment to new operating condition
 - C. Any warranty work requiring shipping or transporting of the equipment shall be performed by the manufacturer at no expense to owner

END OF SECTION

Section 16420 Motor Controllers

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. This section covers motor controllers including; full voltage non-reversing, and solid state reverse voltage rated 600V and below
- D. All motor controller unit manufacturer shall furnish, field test, adjust, calibrate, and certify all installed motor controllers' units for satisfactory operation

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate features of controllers and control devices with pilot devices and control circuits provided under other sections of Specifications covering control systems
- B. Coordinate motor controls, starters and overcurrent devices with motor manufacturer's data. Provide motor manufacturer's data sheets to motor control manufacturer at time of order

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code
- B. NEMA ISC 1, Industrial Control Systems: General Requirements
- C. NEMA ISC 2, Industrial Control Systems: Contactors and Overload Relays, rated not more than 2000 Volts AC or 750 Volts DC
- D. NEMA ICS 6, Industrial Control Systems: Enclosures
- E. UL 508 – UL Standard for Safety Industrial Control Equipment
- F. UL 845 – UL Standard for Safety for Motor Control Centers

1.4 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051
- B. Product Data: Include dimensions, ratings, and data on features and components
- C. Test Results: Certified reports of field tests and observations.
- D. Miscellaneous: Load Current and Overload Relay Heater List: Compiled by Contractor after motors have been installed. Arrange list to demonstrate selection of heaters to suit actual motor nameplate full load currents

1.5 RECORD DRAWINGS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.6 OPERATIONS & MAINTENANCE MANUALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.7 SPARE PARTS

- A. Spare Fuses and Incandescent Indicating Lamps: Furnish one spare for every five (5) installed units, but not less than one set of three (3) of each kind

PART II: PRODUCTS

2.1 manufacturer's

- A. ABB
- B. Eaton
- C. SCHNEIDER
- D. Or approved equal

2.2 motor controllers

- A. Coordinate features of each motor controller with ratings and characteristics of supply circuit, motor, required control sequence, duty cycle of motor, drive, and load, and pilot device, and control circuit affecting controller functions. Provide controllers horsepower rated to suit motor controlled
- B. NEMA Size 1 minimum
- C. Contacts shall open each ungrounded connection to motor
- D. Overload Relays:
 - 1. Ambient-compensated type with inverse-time-current characteristic
 - 2. Provide with heaters or sensors in each phase matched to nameplate full load current of specific motor to which connected with appropriate adjustment for duty cycle. Overload devices to require manual reset after tripping occurs
 - 3. Enhanced Protection Overload Relay: Provide overload relays with NEMA Class 10 tripping characteristics for submersible equipment or where indicated. Select to protect motor against voltage unbalance and single phasing
- E. Enclosures:
 - 1. For individually mounted motor controllers and control devices, comply with NEMA 250

2. Provide enclosures suitable for environmental conditions at controller location
 3. Provide NEMA Type enclosures as indicated or required to suit environment
 4. where located
 5. All enclosures for motor starters 100 hp and greater shall have forced cooling
 6. All enclosures to have 120-volt space heaters
 7. Provide door restraints for all inner and outer doors
- F. Control Diagrams: Provide complete and accurate control diagrams and one-line diagram laminated in clear plastic and installed in door pockets of motor control center

2.3 MANUAL MOTOR CONTROLLERS

- A. Quick-make, quick-break toggle action
- B. Double break silver alloy contacts
- C. Pilot light
- D. Padlocking provision

2.4 MAGNETIC MOTOR CONTROLLERS

- A. Full voltage, non-reversing, across-the-line, magnetic controller, except where another type indicated
- B. Control Circuit: 120 volts. Control power transformer integral with controller where no other supply of 120-volt control power to controller indicated. Control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100% spare capacity
- C. Combination Controller: Switch type; Circuit breaker or non-fused as indicated; quick-make, quick-break switch; factory assembled with controller and arranged to disconnect it. For fused switches, provide rejection type fuse clips and fuses rated as indicated
- D. Combination Controller: Motor circuit protector; molded case circuit breaker type with magnetic only trip element calibrated to coordinate with actual locked rotor current of connected motor and controller overload relays. Provide breakers factory- assembled with controller, interlocked with unit cover or door, and arranged to disconnect controller. Provide motor circuit protectors with field-adjustable trip elements
- E. Overvoltage/Undervoltage/Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting
 1. Provide in starter enclosure for Size 2 and larger starters

2. 2. Delay initial motor start
 3. 3. Delay motor restart due to starter dropout caused by undervoltage or starter coil circuit interruption for maintained control circuit
 4. Adjustable on delay from 0.15 to 30.0 sec set at 10.0 sec
 5. Connect control relay in motor starter coil circuit
 6. Coordinate control relay selection with motor starter to cause motor starter to drop out at voltage slightly higher than dropout voltage of starter and have dropout time slightly faster than motor starter to ensure if motor starter drops out, relay will drop out
- F. For combination starter units provide interlocks so disconnect means must be in "Off" position before door can be opened and so door cannot be closed with disconnect means in "On" position, except by consciously operating permissive release devices. Rotating type operators located outside of door are not acceptable

2.5 SOLID STATE SOFT START

- A. Manufacturer
1. Eaton
 2. Schneider
 3. General Electric
 4. Siemens
 5. ABB
 6. Or approved equal
- B. General description
1. Digital alphanumeric display panel mounted as shown on drawings
 2. Digital control keypad to program controller and select parameters to view
 3. Ethernet connection/calibration capabilities
 4. Display basic functions to include starter status functions, motor status functions, and fault status functions.
 5. Display running codes
 6. Display error codes
 7. Molded case circuit breaker for disconnecting means and emergency shunt trip
 8. Line input isolation contactor
- C. The soft starter shall utilize an SCR bridge consisting of at least two SCR's per phase

- D. The soft starter shall be controlled by a microprocessor that continuously monitors the current and controls the phasing of the SCR's
- E. A shorting contactor shall be standard, and all protective features and control options shall be available even when the shorting contactor is engaged
- F. Construction
 - 1. Units shall be of modular construction so that it is possible to readily interchange units of the same size without modifications to the motor control structure.
 - 2. All conducting parts on the line side of the unit disconnect shall be isolated to prevent accidental contact with those parts.
 - 3. Provisions shall be provided for locking the enclosure with owner's padlock.
 - 4. A shorting contactor shall be supplied in each soft start controller unit to reduce temperature rise within the unit and enclosure. The shorting contactor shall be rated to carry the motor full load current during steady state after full voltage has been applied to the motor by the soft start.
- G. Motor Data
 - 1. The soft start controller unit shall be sized to operate the following AC induction motor:
 - a. Motor horsepower: As indicated on the contract drawings.
 - b. Motor full load ampere: As indicated on the contract drawings.
 - c. Motor voltage: 480
 - d. Motor service factor: 1.15
- H. Environmental Ratings:
 - 1. The soft start controller unit shall be housed in a NEMA Type 1 gasketed indoor motor control center type enclosure. Also reference specification 16482.
 - 2. The soft start controller unit shall be designed to operate while mounted in an enclosure with an ambient temperature from 15 F to 110 F. Provide ventilation fan in MCC bucket.
 - 3. The storage temperature range shall be -13 F to 158 F.
 - 4. The maximum relative humidity shall be 95%, non-condensing.
 - 5. The soft start controller unit shall be rated to operate at altitudes less than or equal to 3,300 ft.
- I. Electrical Ratings:
 - 1. The soft start controller unit shall be designed to operate from an input voltage between -10% and +10% of nominal voltage rating.

2. The soft start controller unit shall operate at 60Hz with a tolerance of + / - 5%.
 3. The soft start controller shall be capable of supplying starting current of 300% of rated full load current, for minimum of 20 seconds.
 4. The SCR's shall have a minimum repetitive peak inverse voltage (P.I.V) rating of 1800 Vac. Lower rated SCR's with MOV protection are not acceptable
- J. Protection:
1. A microprocessor-based thermal protection system shall be included which calculates the temperature-rise of the motor and soft starter and provides:
 - a. A motor overload pre-alarm that indicates by relay contact or logic output that the motor windings have exceeded 130% of its rated temperature rise. This function shall be for alarm only.
 - b. A motor overload fault will stop the motor if the windings have exceeded 140% of temperature-rise.
 - c. An electronic circuit with a time-constant adjustable to the motor's thermal cooling time- constant ensuring the memorization of the thermal state even if power is removed from the soft starter.
 2. The soft starter shall provide line and motor phase loss, phase reversal, underload, stall, and jam protection.
 3. The integral protective features shall be active even when the shorting contactor is used to bypass the SCRs during steady state operation. Shunt trip coil to trip disconnect in the event of a soft starter fault condition including a shorted SCR
 4. The integral protective features shall monitor, alarm and trip, the motor based on the motor winding and bearing temperature reading
- K. Adjustments & Configurations:
1. Digital indication shall provide, as a minimum, the following conditions:
 - a. Soft starter status – ready, starting/stopping, run
 - b. Motor status – current, torque, power factor, elapsed time, power in kW
 - c. Fault status – Motor thermal overload, soft starter thermal fault, loss of line or motor phase, line frequency fault, low line voltage fault, locked rotor fault, motor underload, maximum start time exceeded, external fault, serial communication fault, line phase reversal fault, motor overcurrent fault
 2. Output relays shall be programmed to provide the following status indications:
 - a. One Form A (N.O.) minimum for indication of fault

- b. One Form A (N.O.) for indication that acceleration ramp is complete and current is below 130% motor FLA (ramp complete or motor at speed)
 - c. One Form A (N.O.) assignable to one of the following functions: motor thermal alarm, motor current level alarm, and motor underload alarm
 - 3. Additional inputs and outputs shall be available to provide the following status indications:
 - a. Two assignable control inputs for the following functions: soft stop, pump control, kick start, linear ramp, dual motor or remote control
 - 4. Relay and I/O functions listed above must be isolated with respect to common
 - 5. All programming/configuration devices, display units, and field control wiring terminals shall be accessible on the front of the control module. Circuit boards or electrical power devices shall not be exposed during routine adjustments
- L. Control Characteristics:
 - 1. Starting:
 - a. (Full load) Motor current: 40 to 100 % rated starter current
 - b. Current limit: 300% motor full load current
 - c. Linear (torque-controlled) acceleration ramp time: adjustable 0 to 60 seconds, preset to 15 seconds
 - 2. Stopping:
 - a. Coasting: Power removed from motor with no soft stop
 - b. Brake time by ramp: Soft stop, 1 to 60 seconds, adjustable, independent of starting ramp

2.6 AUXILIARY CONTROL DEVICES

- A. General: Furnish auxiliary control device as shown on 1line diagrams, Drawings, or as specified. Factory-install in controller enclosure except as otherwise indicated
- B. Run/Stop and HOA Selector Switches and Pilot Lights: Heavy duty type
- C. Stop Pushbutton Station: Momentary break pushbutton station with factory-applied hasp arranged so padlock can be used to lock pushbutton in depressed position with control circuit open. (Only where specifically shown on Plans.)
- D. Lockout Pushbutton Station: Maintained contact red mushroom pushbutton station with factory-applied hasp arranged so padlock can be used to lock pushbutton in depressed position with control circuit open. (Only where specifically shown on Plans.)

- E. Control Relays: Auxiliary and adjustable time-delay relays
- F. Elapsed Time Meters: Heavy duty with digital readout in hrs.
- G. Ammeters, Voltmeters, and Frequency Meters: Panel type, 2-inch minimum size with 90- or 120-degree scale, and $\pm 2\%$ accuracy. Where indicated, provide transfer device with off position
- H. Current Sensors: Rated to suit application
- I. Current-Sensing Phase-Failure Relays: Solid-state sensing circuit with isolated contacts for hard-wired connection. Arranged to operate on phase failure, phase reversal, current unbalance of from 5% to 30%, or loss of supply voltage. Provide adjustable response delay
- J. Over temperature sensors are to be installed on transformers in reduced voltage auto-transformer starters. Sensor stall interrupt and lockout starter control circuit. Provide reset switch and alarm light
- K. All well and blower motor starters to have start time delay relay
- L. Contactor shall include minimum of four single pole, double throw spare auxiliary contacts rated at 10 amperes continuous, for each starter furnished

2.7 EQUIPMENT PROTECTION

- A. All equipment, instruments and devices provided for this project shall have means of protection from power line conditions such as surge, phase fail, or other line conditions that may damage equipment, instruments or devices furnished. It is vendors and manufacturers' responsibility to provide protective devices as required for maintaining warranty of furnished items and to assure no damage occurs from power line conditions

PART III: EXECUTION

3.1 PREPERATION

- A. Verify that the location is ready to receive work and the dimensions are as indicated
- B. Do not install the soft start controller unit until the enclosure environment can be maintained within the service conditions required by the manufacturer

3.2 QUALITY CONTROL

- A. Before and during installation, the motor controller shall be protected from site contaminants

3.3 INSTALLATION

- A. General: Install motor controllers and auxiliary motor control devices in accordance with manufacturer's written instructions and approved submittals.
- B. Mounting:

1. For control equipment at walls, bolt single units to wall. Mount multiple units on light-weight structural steel channels bolted to wall
 2. For controllers not at walls, provide freestanding racks fabricated of structural steel members and lightweight slotted structural steel channels. Use feet consisting of 3/8 in. thick steel plates, 6 in. square, bolted to floor. Use feet for welded attachment of 1 1/2 in. by 1 1/2 in. by 1/4 in. vertical angle posts not over 3 ft oc. Connect posts with horizontal lightweight slotted steel channels and bolt control equipment to channels
 3. Unless shown otherwise on plans
- C. Cabinet and Enclosures Heights: Cabinet, panel and enclosure heights shall not exceed 6 feet – 6 inches from floor to top fastening devices to allow access by Operator without use of ladders or steps to open enclosure doors

3.4 CONNECTIONS

- A. Tighten connectors, terminals, and mountings. Tighten field connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torqueing requirements not indicated, comply with tightening torques specified in UL 486A and 486B

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Supplier's or manufacturer's technician for equipment specified herein shall be present at job site or classroom designated by Owner for minimum man days indicated, travel time excluded, for equipment adjustment, and training of Owner's personnel for plant operation. Include minimum of:
1. 2 man-days for Instructional Services.
- B. Testing:
1. Reports: Notify Engineer in writing indicating defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made
 2. On completing installation of system, perform following tests
 - a. Make insulation resistance tests of conducting parts of motor control components; and of connecting supply, feeder, and control circuits. For devices containing solid-state components, use test equipment and methods recommended by manufacturer
 - b. Make continuity tests of circuits
 - c. Review updating of final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents

- d. Review manufacturer's written instructions for installation and testing of motor control devices
3. Visual and Mechanical Inspection: Include following inspections and related work
 - a. Motor Control Device Ratings and Settings: Verify ratings and settings as installed are appropriate for final loads and final system arrangement and parameters. Recommend final protective device ratings and settings where differences found. Use accepted revised ratings or settings to make final system adjustments
 - b. Inspect for defects and physical damage and nameplate compliance with Drawings
 - c. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's written instructions
 - d. Check tightness of electrical connections of devices with calibrated torque wrench. Use manufacturer's recommended torque values
 - e. Clean devices using manufacturer's approved methods and materials
 - f. Verify proper fuse types and ratings in fusible devices.
4. Electrical Tests: Perform following in accordance with manufacturer's written instructions
 - a. Insulation resistance test of motor control devices conducting parts to extent permitted by manufacturer's written instructions. Insulation resistance less than 100 megohms not acceptable
 - b. Use primary current injection to check performance characteristics of motor circuit protectors and for overload relays of controllers for motors 15 hp and larger. Trip characteristics not within manufacturer's published time-current tolerances not acceptable
 - c. Make adjustments for final settings of adjustable trip devices
 - d. Test auxiliary protective features such as loss of phase, phase unbalance, and undervoltage to verify operation
 - e. Check for improper voltages at terminals in controllers having external control wiring when controller disconnect opened. Voltage over 30 v unacceptable
5. Correct deficiencies and retest motor control devices. Verify by system tests that specified requirements are met

3.6 ADJUSTING

- C. Overvoltage/Undervoltage/Phase Failure Control Relay: Adjust control relay to cause motor starter to drop out at voltage slightly higher than dropout voltage of starter and have dropout time slightly faster than motor starter to ensure if motor starter drops out, relay will drop out

3.7 WARRANTY

- D. The motor controller unit shall be warranted to be free from defects in materials and workmanship for a period of two (2) years from substantial completion

3.8 CLEANING

- E. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally using manufacturer's recommended methods and materials

END OF SECTION

Section 16432 Motor Control Center

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only.
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid.
- C. Contractor shall contact and coordinate with local factory representative to verify all equipment purchased conforms to project requirements
- D. Failure to conform with all other specifications, construction drawings, and manufacturer's representatives
- E. Motor control centers as specified and as shown on the contract drawings shall be furnished and installed by the contractor
- F. Section Includes Motor Control Centers (MCC's) for use on AC circuits rated 600 volts or less

1.2 REFERENCES

- A. Refer to other specifications included in construction documents
- B. American National Standards Institute (ANSI): ANSI C2 - National Electrical Safety Code (NESC).
- C. National Electrical Testing Association (NETA): ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. The Motor Control Center shall be manufactured and tested according to the latest applicable standards of the following agencies:
 - 1. UL 486A – Wire Connectors and Soldering Lugs for Use with Copper Conductors
 - 2. UL 845 – Motor Control Centers
 - 3. UL 489 – Molded Case Circuit Breakers
 - 4. NEMA ICS 18-2001 – Motor Control Centers
 - 5. NEMA ICS 2 – Controllers, Contactors and Overload Relays Rated 600V
 - 6. NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600V
 - 7. NEMA ICS 2-322
 - 8. NEMA ICS 1-2001 – Industrial Control and Systems: General Requirements

9. NFPA 70
10. National Electrical Code

1.3 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051
- B. Shop Drawings:
 1. Each MCC including dimensioned plans and elevations and component lists.
 2. Show ratings, including short-time and short-circuit ratings, and horizontal and vertical bus ampacities.
 3. Schedule of features, characteristics, ratings, and factory settings of individual MCC units.
 4. Wiring Diagrams: Interconnecting wiring diagrams pertinent to class and type specified for MCC. Schematic diagram of each type of controller unit indicated.
 5. Dimensioned floor plans with MCC location and required stub-up entries into MCC. Show all pertinent dimensions that verify MCC fits space allocated on plans. Identify areas where equipment fit is a problem and describe any proposed solutions. All equipment shall be fabricated to fit available space shown.
- C. Product Data: Each product and component specified.
- D. Test Results: Certified reports of field tests and observations.
- E. Operations and Maintenance Data: Maintenance data for MCC's.
- F. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark "Complies" or "Non-Compliance" or "Exception" adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.
- G. Provide one-line diagram with MCC submittal showing actual horsepower of motors to be provided for this project. Do not rely solely on plans but rather, coordinate with other vendors providing motors and equipment. Failure to do so will be at Contractor's expense and at no additional cost to Owner.
- H. All submittals for motor control centers, control panels, control sections, SCADA panels, lift pump panels, and Vendor furnished panels must contain statement of U.L. certification and identifying name and number of U.L. certification.

1.4 record drawings

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.5 OPERATIONS & MAINTENANCE MANUALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.6 QUALITY ASSURANCE

- A. Manufacturer: For equipment required for the work of this section, provide products which are the responsibility of one manufacturer
- B. Manufacturer shall have had produced similar electrical equipment for a minimum of 5 years
- C. Manufacturer shall be ISO 9001 certified

1.7 SPARE PARTS

- A. Spare Fuses: Furnish one spare for every five of each type and rating of fuse and fusible devices installed, but not less than one set of three of each kind. Include spares for:
 - 1. Control power fuses.
 - 2. Fuses and fusible devices for fused circuit breakers.
 - 3. Fuses for fusible switches.
- B. Spare Indicating Lights: Furnish five of each type installed.
- C. Touch Up Paint: Furnish three (3) half-pint unopened containers.

PART II: PRODUCTS

2.1 MANUFACTURERS

- A. Eaton
- B. Schneider
- C. Siemens
- D. GE
- E. ABB
- F. Or approved equal

2.2 GENERAL

- A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for MCC's including clearances between MCC's and adjacent surfaces and items and are based on types and models indicated. MCC's of other manufacturers having equal performance characteristics and complying with indicated maximum dimensions may be considered
- B. MCC Starters, MCP, and breaker sizes shall be coordinated with motors supplied and sizes shall be adjusted as required by motor criteria. This

- especially applies to high efficiency motors
- C. Provide motor data to MCC manufacturer at time MCC is ordered to assure coordination of overcurrent protective devices
 - D. Wiring Classification: Class I, Type B, as defined in NEMA ICS 2
 - E. MCC Material: NEMA Type 1, gasketed, as defined in NEMA 250, except as otherwise indicated
 - F. Compartments:
 - 1. Modular, with individual doors with concealed hinges and quick-captive screw fasteners
 - 2. For combination starter units provide interlocks so disconnect means must be in off position before door can be opened and so door cannot be closed with disconnect means in on position, except by consciously operating permissive release device. Rotating type operators located outside of door are not acceptable
 - G. Interchangeability:
 - 1. Construct compartments so it is possible to remove units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in control center
 - 2. Units requiring same size compartment shall be interchangeable, and compartments shall be constructed to permit ready rearrangement of units such as replacing three single units with unit requiring three spaces without cutting or welding
 - H. Wiring Spaces:
 - 1. Provide each vertical section of structure with horizontal and vertical wiring spaces for wiring to each unit compartment in each section
 - 2. Provide separate door over vertical wiring space
 - 3. Provide supports to hold wiring rigidly in place
 - I. Meet current NEC requirements for service entrance
 - J. Ratings: Provide nominal system voltage, continuous main bus amperage, and short time and short-circuit-current ratings as indicated and conform to short circuit and coordination study
 - K. All enclosures for motor starters 100 hp and greater shall have forced air cooling. All outdoor enclosures are to have sufficient forced fan cooling. Provide rain hood, intake louvers, insect screens and fan motor circuits with t-start "On/Off" controls
 - L. Unless specifically noted or shown on plans, all outdoor MCC's shall be NEMA 4X stainless steel with three (3) point latching doors. Indoor enclosures shall be NEMA 1, unless shown otherwise on plans. Where NEMA 1 enclosure is installed outdoors in a NEMA 3R or 4X outer

enclosure, the inner NEMA 1 enclosure shall be independently fabricated and installed, separate from the outer enclosure such that the outer enclosure may be replaced without disturbing the inner enclosure in any manner

- M. All outdoor enclosures shall have means of cooling and/or ventilation where environmental temperatures exceed any internal device ratings
- N. All step-in or walk-in enclosures shall have adequate ventilation for cooling
- O. Door Restraints: Provide door restraints on all doors for outdoor enclosures
- P. All MCC sections to have 120-volt space heater with t-stat
- Q. All connections to devices and controls external to MCC shall be made at terminal strips on blocks only. Direct connection to MCC devices is prohibited
- R. Door latches shall not be operated with hex head type screws. Flat blade screwdriver shall be able to open latches
- S. Provide enclosed type LED light fixture in each MCC section

2.3 RATINGS

- A. MCC shall be 600-volt class suitable for operation on a three-phase, 60 hertz system. The system operating voltage and number of wires shall be as indicated on the drawings

2.4 STRUCTURE

- A. Each standard 20" and 24" wide structure shall be supplied with a vertical wireway. 4" wide wireways shall be installed on 20" wide structures and 8" wide wireways on 24" wide structures. Wireways shall be completely isolated from all power busses. The rear surface of the vertical wireway shall be painted white. A minimum of three (3) formed wire cable supports, extending the full depth of the vertical wireway shall be supplied in each vertical section. A separate hinged door shall cover the vertical wireway.
- B. Each standard structure shall be supplied with a 12-inch top and six (6) inch bottom horizontal wireway that are continuous for the entire length of the MCC. The minimum horizontal wireway opening between sections is 40 square inches for the top and 30 square inches for the bottom horizontal wireway. A hinged door shall be supplied to cover the top horizontal wireway.
- C. Doors are to be hinged in a manner that allows for the removal of individual doors without the removal of any door above or below. Unit doors shall be hinged on the left and vertical wireway doors on the right for unobstructed access to the units and associated vertical wireway. All doors shall be mounted on removable pin-type hinges and secured with steel quarter-turn, indicating type fasteners.
- D. Removable top cover plates shall be provided for conduit entry to the top

horizontal wireway and shall provide a minimum of 116 square inches of area for conduit location. Top cover plates shall be fabricated from 13-gauge steel.

- E. All MCC structures shall be supplied with 1-1/8" high X 3" wide base channel sills that are continuous for the entire length of the shipping split. The base channel sills shall be fabricated of 7-gauge steel and shall be suitable for grouting the base channel sills in place, welding to leveling plates or securing to the floor with 1/2" anchor bolts. MCC structures shall be supplied with reversible bottom end cover plates to cover the bottom horizontal wireway and ends of the base channel sills. The bottom end cover plates shall be factory installed to cover the ends of the base channel sills to prevent entrance of dirt and rodents into the MCC when installed flush on the floor and shall be removable to expose the ends of the base channel sills if they are to be grouted into the floor.
- F. A removable, full length lifting angle shall be provided for each shipping split of each MCC. The lifting angle shall be bolted to each side sheet or divider sheet of the shipping split to evenly distribute the weight of the MCC during lifting.
- G. MCC's shall be assembled in such a manner that it is not necessary to have rear accessibility to remove any internal devices or components

2.5 BUSSING

- A. The main horizontal bus shall be:
 - 1. Tin plated copper rated at the ampacity as specified on the drawings with a conductivity rating of 100% AICS. The horizontal bus bars shall be fully sized to carry 100% of the rated current the entire length of the MCC. Horizontal bus bars shall be mounted edge wise and located at the top of the MCC. Tapered horizontal bus is not acceptable. All power bus shall be braced to withstand a fault current as indicated on the drawings
 - 2. The entire horizontal bus assembly must be located behind the top horizontal wireway at any amperage. Horizontal bus bars located behind usable unit space are not acceptable
 - 3. The horizontal bus shall be isolated from the top horizontal wireway by a clear, flexible, polycarbonate, Lexan®, barrier allowing visual inspection of the horizontal bus without removing any hardware
- B. Ampacity Ratings: As indicated for horizontal main buses and vertical bus sized for indicated loads or 300A minimum.
- C. Neutral Buses: Full size.
- D. Equipment Ground Bus: Non-insulated, horizontal copper bus 2 inches by 1/4 inch, minimum.
- E. Horizontal Bus Arrangement: Extend main phase, neutral and ground buses with same capacity entire length of MCC unless otherwise indicated,

and provision for future extension at both ends by means of bolt holes and captive bus splice sections or approved equivalent.

- F. Natural Disconnect Link: For switchgear assembly having main service disconnect. Arrange to permit disconnecting the switchgear assembly neutral bus from the common ground bus and the incoming service neutrals. Also, provide a bolted, un-insulated, ¼ inch x 2-inch copper bus (main bonding jumper). Arrange to interconnect the neutral and the ground buses to establish the system common ground point.
- G. Short-Circuit Withstand Rating: Same as short-circuit current rating of section.
- H. The vertical bus:
 - 1. Vertical bus bars shall be fabricated of tin-plated solid copper bars with a conductivity rating of 100% AICS
 - 2. The vertical bus barrier support shall be designed as to effectively enclose each vertical bus bar. Automatic shutter mechanisms shall be provided to close off all unused stab openings when a plug-in unit is moved to the "TEST" position or removed from the structure. Unused stab openings shall be covered with snap-in covers
- I. All bus ratings are to be based on a maximum temperature rise of 65°C over a 40°C ambient temperature
- J. Horizontal to vertical bus and horizontal bus splice connections shall be made with two (2) 3/8" grade 5 bolts and Belleville-type conical washers at each connection point. All connecting hardware shall be designed to be tightened from the front of the MCC without applying any tools to the rear of the connection
- K. The horizontal ground bus shall be copper

2.6 UNITS

- A. Plug-in units shall connect to the vertical bus by means of self-aligning, tin plated copper stab-on connectors provided with spring steel back-up springs to insure positive connection to the vertical bus.
- B. The interior of all MCC units shall be painted white, including unit top and bottom plates or isolation barriers.
- C. All plug-in units 12" tall and larger will include two (2) auxiliary handles to aid in installation, removal and transporting plug-in units.
- D. All plug-in units will include a racking mechanism to assure full engagement with the stab-on connectors with the vertical bus.
- E. Plug-in units shall be provided with interference type draw-out to prevent complete removal of the plug-in unit from the structure in one motion. The interference mechanism shall also provide clear indication when the plug-in unit has been withdrawn to the "TEST" position.

- F. A mechanical interlock shall be supplied on all plug-in units to prevent insertion or removal of a unit from the structure when the unit operator handle is in the ON position. This interlock may not be defeated.
- G. Each 12" tall and larger plug-in unit shall be secured in the structure by two (2) readily accessible devices, one of which is tool operated. These devices shall be located at the front of the unit.
- H. Plug-in units with NEMA Type B or C wiring shall be supplied with unit terminal block mounted on the right-hand side of the unit, adjacent to the vertical wireway. The terminal blocks shall be mounted on a movable bracket that maintains the terminals inside the unit structure for normal operation and pivots into the vertical wireway exposing the terminals for wiring, test and maintenance.
- I. All plug-in units shall include a positive means of grounding the unit to the structure at all times.
- J. The MCC unit disconnect operator for 600 ampere maximum units shall operate in a vertical, up-down, plane. High density units shall have horizontal motion. All unit disconnects shall remain engaged with the disconnect device at all times, regardless of the unit door position. The operating handles shall be interlocked with the unit door so that the door can neither be opened with the disconnect device in the ON position, nor can the disconnect device be turned ON with the unit door open except by operation of a defeater mechanism. Indication of the disconnect device shall be clearly indicated by the position of the operating handle. When applied with circuit breaker devices, the handle shall also provide clear indication of a circuit breaker trip.
- K. When pilot lights, push buttons or sector switches are specified. The devices shall be mounted in a formed metal device panel that is capable of accepting four (4) such devices in any combination. The device panel shall be secured to the unit door for normal operation or mounted on the plug-in unit as required for unit removal and bench testing.
- L. Pilot devices shall be heavy duty, oil tight 30mm devices with a NEMA 4 rating. Pilot device contacts shall be rated at 10A, 600 VAC (NEMA A600). The pilot device bodies shall be fabricated from metal.
- M. Unit identification nameplate shall be provided for each unit. Nameplates shall be a black surface with white core. Engraving shall cut through the gray surface exposing white lettering of the unit designation. Nameplates shall be 1" tall by 3 1/2" wide. Adhesives or glues are not an acceptable means of mounting unit nameplates.

2.7 POWER QUALITY METER

- A. Multifunction Digital-Metering Monitors shall be UL-listed or recognized, microprocessor-based unit suitable for three or four wire systems. Units shall communicate via:

1. Ethernet TCP/IP expansion module
 2. Interface with SCADA capability
 3. Spare parts per motor starter including:
 - a. GE PQM-II
 - b. Shark
 - c. Eaton EPM 7000 series
 - d. Eaton EPM 9700
 - e. Eaton EPM9800
 - f. Eaton EPM 9900P
 - g. 25% of total control relays utilized
 - h. 25% of total fuses utilized
 - i. 25% of total power and logic boards/modules dedicated on SCADA system
 - B. The meter shall mount on the door and shall monitoring the system as indicated on the drawings
 - C. Metering Equipment:
 1. Provide a multi-function, high accuracy digital power metering instrumentation module equipped with LCD display. The power metering module shall provide simultaneous measurements for current, voltage and power parameters. Power meter shall be Siemens type PAC5200equipped with a communications port for standard RJ-45 and RS-485 connection
- 2.8 FUNCTIONAL FEATURES**
- A. General: Provide modular arrangement of motor controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center as indicated.
 - B. Motor Controller Units:
 1. Combination controller units; of types and with features, ratings, and circuit assignments indicated.
 2. Units with full-voltage, across-the-line, magnetic controllers up to and including Size 3 shall be installed on draw out mountings with connectors that automatically line up and connect with vertical section buses while being racked into their normal energized positions.
 3. Units shall have short-circuited current ratings equal to or greater than short-circuit current rating of MCC section.
 4. Units in MCC's shall be equipped with pull-apart terminal strips or draw out terminal boards for external control connections.
 5. All autotransformer type start installation shall be coordinated with

- power factor capacitors to avoid resonant conditions that might produce harmonics.
- 6. All autotransformer type starters to have temperature sensor devices. Connect to controls to protect autotransformer from over-temperature.
- C. Overcurrent Protective Devices:
 - 1. Individual feeder tap units through 225 ampere rating shall be installed on draw out mountings with connectors that automatically line up and connect with vertical section buses while being racked into their normal energized positions
 - 2. All equipment feeder and/or motor circuit breakers (not MCP) are to have plug-in trip unit
 - 3. Motor Circuit Protectors (MCP) shall be electronic type that learn inrush current and adjust accordingly
- D. Overload Relays:
 - 1. Ambient-compensated type with inverse-time-current characteristic
 - 2. Provide with heaters or sensors in each phase matched to nameplate full load current of specific motor to which connected with appropriate adjustment for duty cycle. Overload devices to require manual reset after tripping occurs
 - 3. Enhanced Protection Overload Relay: Provide overload relays with NEMA Class 10 tripping characteristics for submersible equipment or where indicated. Select to protect motor against voltage unbalance and single phasing
 - 4. Select overload heaters and relays based on Motor Manufacturer's requirements, or based on motor nameplate data, size at 1.15 FLA (nameplate). Measure actual FLA in operation and provide data in O&M Manual. Where overloads trip during normal operation, provide current recordings to analyze cause and time of events, and provide data to Engineer for recommended corrective action
- E. Coordinate size of circuit breakers, trip units, MCP's and other overcurrent protective devices, with motor manufacturer's and provide proper rated devices accordingly
- F. Spaces and Blank Units: Compartments fully bussed and equipped with guide rails or equivalent, ready for insertion of draw out units
- G. Spare Units: Type, sizes, and ratings as indicated, and installed in compartments indicated "spare."
- H. All motor starter controls are to include ETM, HOA, and Run light as a minimum
- I. Control Diagrams: Provide complete and accurate control diagrams and one-line diagram laminated in clear plastic and installed in door pockets of

motor control center

- J. All control transformers shall be sized for 250 percent of full load
- K. All display screens or readouts shall be mounted in panel at height of 60 inches above level where operator stands. This must be accounted for where panels are installed on concrete pads or other elevated structures
- L. Inhibit Relays: Where generator is not designed to carry full load of motors, provide inhibit relay for each motor starter over 5 horsepower to inhibit motor starter operation when generator runs. Relay is to be energized by generator run signal from ATS or generator. Provide bypass switch across the inhibit relay contacts to allow selected motors to run on generator power
- M. Provide one (1) additional auxiliary contact for each motor starter
- N. Manufacturer to provide all controller addresses, HMI and OIU templates and other data pertinent to SCADA programmer. No exceptions

2.9 IDENTIFICATION PRODUCTS

- A. Provide identifying devices
- B. Equipment Markers: Provide 2 ply, 1/8 in. thick laminated plastic, engraved equipment markers
 - 1. Color: Black letters on white background
 - 2. Nomenclature: Include following, matching terminology on schedules as closely as possible:
 - a. Equipment name (i.e. motor control center)
 - b. Equipment Tag No. (i.e. 30 MCC 1)
 - 3. Size: Provide approximate 3 in. by 6 in. (minimum) for equipment
 - a. 1 in. high letters for equipment tag number
 - b. 1/2 in. high letters for descriptive equipment name
 - 4. Size: Provide approximate 1 1/2 inch by 3 inch (minimum) for device or component
 - a. 1/4 inch high letters for equipment tag number
 - b. 1/4 inch high letters for descriptive equipment name
 - 5. Fasteners: Self-tapping stainless-steel screws except contact type permanent adhesive where screws cannot or should not penetrate substrate
- C. Wire Markers: Provide wire markers for all power and control wiring. Install at points where wire terminates at devices and terminal strip

2.10 FINISHES

- A. Manufacturer's standard finish suitable for environment in which installed

PART III: EXECUTION

3.1 TESTING

- A. Perform factory and installation tests in accordance with applicable NEC, NEMA and UL requirements
- B. Check tightness of all accessible mechanical and electrical connections to assure they are torqued to the minimum acceptable manufacturer's recommendations
- C. All elements of each electrical control system shall be tested to demonstrate that the total system satisfies all of the requirements of this Specification. All special testing of materials and equipment shall be provided by the Contractor
- D. The Contractor shall coordinate and schedule all of his testing and startup work with the Owner and Systems Integration Engineer. As a minimum, the testing shall include both a factory test and a field test
- E. Factory Tests: The electrical controls and all other associated hardware shall be tested via a full simulation at the factory, prior to shipment, to demonstrate that each component is operational and meets the requirements of these specifications. Manufacturer shall provide test routine program for shop testing of I/O wiring. Test results shall be certified, with written documentation provided to the Engineer upon test completion. Factory testing may be witnessed by the Engineer
- F. Field Tests: All electrical control system components shall be checked to verify that they have been installed properly and that all terminations have been made correctly. Witnessed field tests shall be performed on the complete system. Contractor shall provide a checklist for all electrical, control and instrumentation functions and send to Engineer for approval. Each function shall be demonstrated to the satisfaction of the Owner and Engineer on a paragraph-by-paragraph basis. Each test shall be witnessed and signed off by the Contractor and the Engineer upon satisfactory completion. The Contractor shall notify the Owner at least 2 weeks prior to the commencement date of the field tests. After tests are completed and with system fully operational, system shall run continuously for a period of 10 days without failure. Any failures shall be repaired, and test shall start over again
- G. Comply with applicable requirements of National Electrical Testing Association (NETA) Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems."
- H. Reports: Notify Engineer in writing indicating defective materials and workmanship and unsatisfactory test results. Include record of repairs and adjustments made.
- I. Perform following tests:

1. Test insulation resistance of MCC buses; components; and of connecting supply, feeder, and control circuits. For components with solid-state devices or other sensitive components, perform tests in accordance with manufacturer's instructions.
 2. Make continuity tests of circuits.
 3. Inspect MCC's for defects and physical damage, testing laboratory labels, circuit connections, and nameplate compliance with up-to-date system drawings.
 4. Perform operational test and exercise of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 5. Check MCC anchorage, external clearances, and alignment and fit of components including internal elements.
 6. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
 7. Perform visual and mechanical inspection and related work for motor control and protective devices.
 8. Device Ratings and Settings: Verify ratings and settings of overload relays, motor circuit protectors, and overcurrent protective devices.
- J. Quality Control Testing Program: Assure MCC installation meets specified requirements, is operational within specified tolerances, and provides appropriate protection for systems and equipment.
1. Test and inspect MCC's in accordance with manufacturer's recommendations and these specifications.
 2. Schedule tests and provide notification at least 7 days in advance of test commencement.
 3. Reports: Prepare written reports of test results and observations. Report defective materials and workmanship. Include complete records of adjustments and corrective action taken.
 4. Labeling: On satisfactory completion of tests and related effort, apply label to tested components indicating results, person responsible, and date.
 5. Test insulation resistance of buses and portions of control wiring that disconnect from solid-state devices through normal disconnecting features. Insulation resistance less than 100 megohms is not acceptable.
 6. Verify appropriate capacity, overcurrent protection, and operating voltage of control power elements including control power transformers and control power wiring.
 7. Check phasing of supply source to bus.

8. Test motor-control devices.
9. Test overcurrent protective devices.
- K. Retesting: Correct deficiencies and retest. Verify by retests that specified requirements are met.
- L. SCADA Control cabinet
 1. Controller Program: Testing will require a minimum of 10 working days after programs are downloaded to the pump controller. Provide 4 weeks' notice for program downloading by Programmer. This shall be accounted for in project schedule
 2. Prior to testing system, or PLC programs or HMI programs provided by other than the Systems Integration Engineer shall be furnished on CD for review by Engineer. Provide any special software necessary to run and test complete program

3.2 PREPERATION

- A. Deliver in shipping splits of lengths that can be moved past obstructions
- B. Store so condensation will not occur on or in MCC's. Provide temporary heaters as required to prevent condensation
- C. Handle MCC's in accordance with NEMA ICS 2.3, "Instructions for Handling, Installation, Operation, and Maintenance of Motor Control Centers." Use factory-installed lifting provisions
- D. Temporary Heating: Apply temporary heat in accordance with manufacturer's recommendation within each section of switchgear throughout periods during which the switchgear is not in a space that is continuously under normal control of temperature and humidity

3.3 INSTALLATION

- A. Install per manufacturer's recommendations and contract documents
- B. Provide MCC that fits space available. Where dimensions exceed available space, sections are to be relocated in room or, MCC shall be specifically manufactured for this project to accommodate the space restrictions at no additional cost to Owner. Contractor shall contact Engineer before ordering equipment or installing conduits where space restriction exists
- C. General: Install MCC's in accordance with NEMA ICS 2.3 "Instructions for Handling, Installation, Operation, and Maintenance of MCC's," and with manufacturer's written installation instructions.
- D. Anchor each motor-control center assembly to concrete base in accordance with manufacturer's recommendations. Level and grout sills flush with motor-control center mounting surface.

- E. Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from MCC units and components.
 - F. Install separate independent anchor bolts for NEMA 1 enclosure where based outdoors with an outer enclosure. Outer enclosure shall be removable without disturbing inner enclosure, as described in this Specification Section.
 - G. All components inside enclosures shall be fastened down with proper hardware. All cables shall be bundled and bound with waxed cord or nylon tie-raps manufactured for that purpose. Adhesive tie down blocks are not allowed. Provide threaded press-in or welded studs for nylon cable clamps as required.
 - H. Contractor shall coordinate all conduit stub-ups into MCC. Any mis-located conduits shall be relocated at Contractor's expense and at no additional cost to Owner.
 - I. All motor control centers shall be fabricated to fit space available as shown on plans, even when special fabrication is required.
 - J. SCADA Cabinet
 - 1. Where controls section is fabricated by other than MCC Manufacturer, a matching controls sections shall be provided and shipped to controls fabrication shop at time MCC is ordered so as to expedite controls assembly
 - 2. Cabinet and Enclosures Heights: Cabinet, panel, and enclosure heights shall not exceed 6 feet – 6 inches from floor to top fastening devices to allow access by Operator without use of ladders or steps to open enclosure doors
- 3.4 CONCRETE BASES
- A. Provide 4-inch high concrete foundation on pad under MCC or as shown on plans
- 3.5 IDENTIFICATION
- A. Place wire identification tags at each end of all conductors
- 3.6 CONNECTIONS
- A. Tighten MCC bus joint bolts, electrical connector, and terminal bolts in accordance with Manufacturer's installation instructions and torque-tightening values. Where manufacturer's torque values are not stated, use those specified in UL 486A and UL 486B
- 3.7 ADJUSTMENT/CALIBRATION
- A. The Contractor shall perform field adjustments of the short circuit and overload devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study, protective device

coordination study, manufacturer's instruction leaflets, and the contract documents

3.8 CLEANING

- A. Inspect interior and exterior of MCC's. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish

3.9 MAINTENANCE/WARRANTY

- A. Contractor shall provide full 3-year service warranty on the overall installation and shall include all labor and materials required to repair or replace equipment and/or components that are defective or malfunctioning. Included under this warranty shall be all equipment, devices, hardware, and software. This warranty shall begin on date of written "Final Acceptance" of the electrical systems and to be executed as required at no additional cost to the Owner. Contractor's warranty shall also guarantee 24-hour service response time and shall provide labor, work, or materials as necessary to maintain plant operation when replacement parts are on order. In no case shall plant electrical systems be out of service for more than 24 hours from time Owner calls for warranty service. This shall be provided at no additional cost to the Owner. All equipment and materials installed shall have full warranty from Manufacturer that guarantees equipment is rated for harsh industrial electrical/mechanical environment in which it is installed
- B. Where Manufacturer's products fail prematurely, Manufacturer shall be fully responsible for new replacement and shall not have the option of declaring that failures were caused by environmental conditions and its affect on the product. Contractor is fully responsible for assuring that Product Manufacturers are aware of this condition and that warranty statement is included in shop drawing submittals. Failure to do so will be at the Contractor's expense and at no additional cost to the Owner.
- C. All critical warranted repairs shall be made within 24 hours of receipt of required parts from Manufacturer with reasonable delivery time of overnight shipping. Any repairs not completed within 5 working days from date of notice are subject to Owner making other arrangements for repair and back charging Contractor. This requirement is a condition of this contract.
- D. Where equipment or instrument problems remain unresolved by Contractor beyond a reasonable time, a Factory Technician shall be provided on-site to take any corrective actions necessary to put equipment or instruments in operating order. Owner and Engineer reserve the right to determine a reasonable time for corrective action by Contractor.

END OF SECTION

Section 16433 Control Panel

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. This section describes the requirements for a quality construction and fabrication of SCADA/Control Panels including power, control, and instrumentation related equipment
- D. This section will also describe desired operation of facility
- E. All equipment described herein shall be submitted, and factory installed, as an integral part of equipment specified in overall construction documents
- F. Insert half-size blackline prints of wiring diagrams applicable to each control panel in a clear plastic envelope and store in a suitable print pocket or holder inside each control panel.

1.2 PRICE AND PAYMENT PROCEDURES

- A. No separate payment for work performed under this section. Include cost for SCADA/Control Panels in overall electrical equipment

1.3 REFERENCES

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 volts maximum)
- B. ANSI/NFPA 70 - National Electrical Code (NEC)
- C. Underwriters Laboratories, Inc. (UL)
- D. Factory Mutual (FM)
- E. Occupational Safety and Health Administration (OSHA)
- F. American National Standards Institute (ANSI)
- G. NEMA ICS 1 - General Standards for Industrial Control and Systems
- H. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies
- I. NEMA ICS 3 - Industrial Systems
- J. NEMA ICS 6 - Enclosures for Industrial Controls and Systems
- K. NEMA ST 1 - Standard for Specialty Transformers (Except General Purpose Type).
- L. ISA - Instrument Society of America
- M. FM - Factory Mutual

- N. IEEE - Institute of Electrical and Electronic Engineers
- O. NFPA - National Fire Protection Association
- P. JIC - Joint Industrial Council

1.4 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051
- B. Panels, Consoles, and Cabinets Information:
 - 1. Layout Drawings include the following:
 - a. Front, rear, end, and plan views to scale.
 - b. Dimensional information.
 - c. Tag number and functional name of components mounted in and on panel, console, or cabinet.
 - d. Product information on all panel components.
 - e. Nameplate location and legend including text, letter size, and colors to be used.
 - f. Location of anchoring connections and holes.
 - g. Location of external wiring and/or piping connections.
 - h. Mounting and installation details.
 - i. Proposed layouts and sizes of graphic display panels.
 - 2. Wiring and/or piping diagrams include the following:
 - a. Name of panel, console, or cabinet.
 - b. Wiring sizes and types.
 - c. Piping and tubing sizes and types.
 - d. Terminal strip numbers.
 - e. Color coding.
 - f. Functional name and manufacturer's designation for components to which wiring, and piping are connected.
 - 3. Electrical control schematics in accordance with JIC standards.
 - 4. Plan showing equipment layout in each area.
- C. Field wiring and piping/tubing diagrams, include the following:
 - 1. Wiring and piping/tubing sizes and types.
 - 2. Terminal strip numbers.
 - 3. Color coding.
 - 4. Conduits in which wiring is to be located.
 - 5. Location, functional name and manufacturer's designation of items to which wiring and/or piping are connected.
 - 6. Point-to-point wiring diagrams

1.5 record drawings

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.6 operations & maintenance manuals

- A. Refer to specification for Basic Submittal and O&M Requirements 16051
- B. Accurately record actual locations of control cabinets and input and output devices connected to system. Include interconnection wiring and cabling information and terminal block layouts in control cabinets, inserted in an aluminum drawing pocket on inside of door.
- C. During drawing submittal phase, submit detailed information consisting of ladder logic and line code, complete input, output, relay and controls identification labels and written description of program operation. Ladder logic diagrams submitted shall contain a written descriptive note for each line, describing the function and logic of that line. Submit all documents in hard copy and on CD.
- D. Submit factory-testing procedures proposed to verify all input, output, loop operation, and system logic verification. Testing procedures submitted shall detail, as a minimum, verification of the following required minimum functions:
 - 1. Verify motor start, motor stop, and level or pressure alarm outputs by simulating signals representing levels or pressures.
 - 2. Verification of each discrete input via external manually operated connection.
 - 3. The system shall be tested and verified with all external devices required to simulate field connections connected simultaneously for a full system test.

1.7 Quality assurance

- A. Any manufacturer that cannot meet the requirements of this specification will not be considered

PART II: PRODUCTS

2.1 MANUFACTURERS

- A. Rittal
- B. Hoffman Enclosures
- C. NEMA Enclosure Manufacturing Co.
- D. Approved equal quality

2.2 WIRING METHOD

- A. Install wiring in open-slot plastic wiring duct or Panduit wireways

- B. Where wireways are used, they shall be properly sized for wiring contained within and shall not be oversized. Wireway fill shall not exceed 75 percent of wireway capacity and shall not be less than 25 percent of wireway capacity. Wireway width to depth ratio shall not be less than 2 to 1
- C. Do not use adhesive type cable ties. Attached with stainless steel bolts or welded studs
- D. Provide thermostat-controlled strip-type space heater (150 watts maximum), convenience outlets and internal fluorescent lighting (where shown on drawings)
- E. Nameplates: On the outside of each cabinet's inner door, provide motor data nameplate information for each pump motor; copy all information exactly as shown on each motor nameplate. Provide engraved laminated plastic nameplates; black letters with white background; fasten to outside of cabinet door of each motor starter section with stainless steel screws
- F. All equipment and devices shall be NEMA rated. IEC rated equipment and devices are not acceptable
- G. A divider of same material and thickness as the cabinet shall be added to divide electrical components and wiring from instrumentation and pneumatic components and wiring
- H. All interconnect wiring inside panel to be stranded copper conductors intended for panel wire use. Thermoplastic covered wire is not to be used.
- I. Cable ties shall be spaced at intervals not to exceed 4 inches. All wiring between device terminals and wireways shall be orderly and tied. Wire markers shall be visible without removing wiring from a wireway
- J. All cable ties shall be trimmed, and loose ends shall not exceed 1/8 inch in length after trimming
- K. Wiring bundles shall be secured in place with nylon cable clamps that are attached to the mounting plate with stainless steel bolts. Cable bundles attached to the back side of a front plate or cover plate shall be via steel studs welded to the plate before painting. Counter sunk head steel bolts may be used in which case the head finish shall match the panel finish in color so as to provide a neat appearance of the front panel
- L. Wire splices inside panels are prohibited. Wire nuts and similar devices are prohibited. Split, bridged, or extended circuits shall be done via use of terminal strips only except where looped grounds or power circuits may be used where wire is not cut and is attached at each device with proper terminal devices. All circuits shall be continuous and unbroken
- M. Use wire strippers of proper size to avoid wire nicks or cut strands. Trimming strands to make wire fit a terminal is prohibited. Provide proper sized wire and/or terminal device

2.3 DEVICE MOUNTING

- A. All devices mounted on plates or doors shall be installed in holes that are punched with dies that specifically match the device requirements. Holes may be formed with machine tools. No mounting holes are to be cut with saws, nibblers, or similar tools not made for professional panel fabrication. All edges to be smooth and free of burrs
- B. Panels that have scratches or are otherwise damaged when mounting devices may be touched up with the same identical paint where dried under the same conditions of heat or drying as the original panel finish. Repairs shall not be detectable
- C. All panels to be constructed of 316 stainless steel, 16 gauge painted steel, or 16-gauge aluminum, as noted on plans. All doors to be constructed so as to prevent flexing or twisting movement when opened. This is especially of concern when devices are mounted on door. Lightweight doors are not acceptable. Inner panel is to be aluminum or steel. Plexiglas panel is not acceptable
- D. Where panel is provided by an Equipment Manufacturer as part of the specified equipment package, the Equipment Manufacturer shall be held to these same standards and requirements. Providing panels of less quality than these standards will not be acceptable regardless of Equipment Manufacturer's standard panel specification described in equipment data sheets. Other specification sections of lesser quality do not supersede the requirements of this specification section
- E. No devices shall be mounted in outer door of panels except where specifically noted on plans. Where instruments are mounted in panel doors or plates, the mounting devices, clips, and brackets shall be type provided by the Instrument Manufacturer or shall be specifically fabricated for the purpose. All panel mounted instruments shall have enclosures that cover any exposed circuit boards or components on the back side of the instrument
- F. Components are to be attached with bolts, washers, and nuts properly sized and made for the purpose applied. Screws or self-tapping screws are not acceptable for mounting components, except self-tapping stainless screws shall be used for mounting nameplates
- G. Do not mount temperature sensitive devices near heat producing components such as resistors or transformers
- H. Arrange all devices for easy identification, removal, and repair. Removal of any device shall not require removal or disturbing other components
- I. Wet devices shall be located in lower part of panel or cabinet with metallic spray shield installed above, separating other electrical devices
- J. DIN rail mounted devices shall be made for purpose and shall be standard sized components. Micro and miniature type components are not

acceptable. Provide additional 8-inch DIN rail for future devices

- K. All devices shall be of type that is readily available and not special-order type components that are not standard manufactured units
- L. All components, parts, and devices are to be identified at their locations with approved labels or nameplates. Provide 8 ½ x 11-inch laminated parts list in steel or hard plastic door pocket along with the control diagrams
- M. All over current devices shall be fast acting circuit breakers. Fuses are not allowed except where specifically called for. Where fuses are specified, provide ten (10) each spare fuses in addition to requirements of other specification sections
- N. Fused circuits are not acceptable for power or control devices. Circuit breakers shall be used for all overcurrent protection purposes. Any use of fuses shall be acceptable where specifically approved by Engineer in writing for each specified panel
- O. All display screens or readouts shall be mounted in panel at height of 60 inches above level where operator stands. This must be accounted for where panels are installed on concrete pads or other elevated structures

2.4 TERMINALS

- A. All terminations for interfacing with external wiring shall be via screw type terminal strips that have numbered markings to identify termination points. All terminals to have compression plates made specifically for the purpose, in addition to the screws. Round washers are not acceptable substitute for the compression plates
- B. All terminals or exposed wiring with more than 120 volts to ground or 300 volts between legs are to be shielded with non-metallic, non-conducting insulating material made for the purpose of avoiding accidental contact. Label all shields and devices in a recognizable manner with warning nameplate or sign
- C. Locate terminal strips in accessible location in panel to allow easy access when making terminations. Provide nameplate for each terminal strip

2.5 MISCELLANEOUS

- A. Door fasteners shall be of highest quality, designed to withstand repeated engagement and disengagement without damage to retaining parts, which shall be firmly attached to the panel frame members. Fasteners shall be properly aligned with retainer parts. Lightweight fasteners are not acceptable. Any fasteners failing before warranty period expires shall be replaced with different type fastener that is acceptable to Owner and Engineer
- B. All outdoor panel doors to be NEMA 4X 316 stainless steel unless specifically noted on plans, with three (3) point latching handle and locking hasp. Key type handles are not acceptable. No control devices are allowed on outer door of outdoor enclosures

- C. All attachments and studs that are welded to stainless steel panel, enclosure, or plate shall be properly welded in such a manner that does not discolor finish. All welds shall be properly cleaned, buffed, and treated to provide a neat appearing finish. Any discolored plates or enclosures shall be replaced
- D. Panel Manufacturer shall send Engineer color photographs or e-mail color photo files of finished panel where shop inspection has not been conducted before shipping. Photos shall be of quality and clarity so as to allow evaluation of finished panel quality. No panels shall be delivered to job site without this review and approval in writing by Engineer and, where delivered without this approval may be rejected by Engineer. Any delay in construction due to failure to satisfy this requirement will be at fault of contractor
- E. Relocation of panels up to 40-feet from where shown may be required and shall be included in bid cost

2.6 CLIMATE CONTROLLED CONTROL PANEL

- A. Enclosure Type: NEMA 1

2.7 OUTDOOR RATED CONTROL PANEL

- A. Enclosure Type: NEMA 4X 316 S.S.
- B. Enclosure Size: As indicated on Drawings, or if not indicated, at least 72 inches high by 60 inches wide by 36 inches deep, or larger, as required to accommodate equipment and as indicated in UL standards. Where small motors under quantity of three (3) are served, cabinet may be sized to accommodate components and may be less than 60 inches wide and 36 inches deep. Where on concrete pad higher than 12 inches, the height may be reduced to allow access to top controls
- C. Doors: Stainless steel pan-type construction, with full-length stainless-steel piano hinge (for stainless steel or aluminum). Equip exterior doors with padlock, heavy-duty locking pistol-grip handles and 3-point latching mechanism of the draw roller type (0.750-inch minimum diameter rollers). Handles shall be 3/4-inch minimum diameter stainless steel. Equip interior doors with flush quarter-turn closure devices. Equip interior and exterior doors with neoprene gaskets. Provide rear doors for access to power devices in rear and control devices in front where shown on plans
- D. Provide rain shield with 1-inch drip lip for outdoor cabinets to protect against direct sun radiation and rainfall where overhead canopy is not shown on construction documents. Design shield to provide 1 foot of cover front and back and 2 inches of cover on the sides. Design shield to provide no more than 1-foot peak height above the top of the panel with 1-inch airflow clearance from the top of the control panel. Shielding material: Type 316 stainless steel. Maintain minimum 7 feet head clearance from finished grade

- E. In each cabinet section, provide a 120-volt convenience outlet and a switched LED light fixture
- F. Inside and outside of cabinet shall be smooth and free from burns
- G. NEMA 4X enclosures shall have all bolt holes gasketed
- H. Provide locking hasp on all enclosures unless noted otherwise on plans.
- I. Outdoor enclosures shall not have exposed devices or controls mounted on outer door and, no see-through windows or covers are allowed unless specifically shown on plans

PART III: EXECUTION

3.1 QUALIFIED ELECTRICAL CONTRACTORS

- A. Only qualified manufacturers listed may assemble controller panels for this project
- B. Manufacturer: Company specializing in manufacturing the assembled control products specified in this specification section with minimum 5 years documented experience, which maintains service facilities within 200 miles of project, and with proven compatibility with owner's existing type facilities. All equipment shall be coordinated with qualified integrators and manufacturers covered in the construction documents prior to bid
- C. Control/SCADA panel may be assembled by the following prequalified integrators:
 - 1. Ace Controls
 - 2. Five Star Electric
 - 3. Texas Industrial Control Manufacturing (TICM)
 - 4. Weimar Manufacturing
 - 5. W.W. Payton Corp.
 - 6. Systems, Inc.
 - 7. Or as pre-approved by engineer prior to bid

3.2 TESTING

- A. All elements of each electrical control system shall be set up, calibrated, and tested by Manufacturer's Technician to demonstrate that the total system satisfies all of the requirements of this Specification. All special testing of materials and equipment shall be provided by the Contractor. The Contractor shall coordinate and schedule all of his testing and startup work with the Owner and Systems Integration Engineer. As a minimum, the testing shall include both a factory test and a field test. Testing requirements are as follows:

1. Factory Tests: The electrical controls and all other associated hardware shall be tested via a full simulation at the factory, prior to shipment, to demonstrate that each component is operational and meets the requirements of these specifications. Manufacturer shall provide test routine program for shop testing of I/O wiring. Where solid-state controller programs are furnished by a specified Systems Integration Programmer, a copy of the program will be provided for Manufacturer's use in factory testing. Test results shall be certified, with written documentation provided to the Engineer upon test completion. Factory testing may be witnessed by the Engineer and/or Programmer.
 2. Field Tests: All electrical control system components shall be checked to verify that they have been installed properly and that all terminations have been made correctly. Witnessed field tests shall be performed on the complete system. Prior to witnessed test, Contractor shall perform a complete test of each and every function, device operation and overall operations of electrical power, control, instrumentation and SCADA system. Prior to loading PLC or SCADA programming and prior to any PLC or SCADA set up by programmer, an inspection shall be conducted by Engineer's Inspector to assure electrical controls are functioning properly. Any discrepancies or problems shall be corrected and then Contractor shall send a written notice that complete electrical control system is installed and operating per the Plans and Specifications. This notice shall be signed by an Officer of the General Contractor's company. Contractor shall provide a checklist for all electrical, control and instrumentation functions and send to Engineer for approval. Each function shall be demonstrated to the satisfaction of the Owner and Engineer on a paragraph-by-paragraph basis. Any equipment, devices or functions that are found not performing properly will be reason for termination of test until repairs are made. Additional testing by Engineer and Owner may be at Contractor's expense for time and travel of Engineer and Owner's staff.
- B. A state licensed Electrician shall be present at all scheduled inspections.
 - C. Controller Program: Remote testing by Engineer will require a minimum of 30 working days after programs are downloaded to the controller. Provide six (6) weeks' notice for program downloading by Programmer. This shall be accounted for in project schedule. Any delay of project completion due to lack of notice is at Contractor's risk and expense
 - D. Prior to testing system, PLC programs or HMI programs provided by other than the Systems Integration Engineer, programs shall be furnished on CD for review by Engineer. Provide any special software necessary to run and test complete program
 - E. Modem and/or radio system setup shall be conducted by Manufacturer's Technician before any field-testing by Engineer is performed. Set up per Manufacturer's written instructions. Provide Engineer with checklist and values of all settings and adjustments before requesting field test by

Engineer. Indicate impedance of terminal load resister at each end of modem line

3.3 PREPERATION

- A. Verify that surface and job conditions are ready for construction; report unsatisfactory conditions to the Engineer. Do not proceed with work until unsatisfactory conditions have been corrected
- B. Deliver products to site in acceptable condition and in protective wrappings
- C. Store and protect products from damage
- D. Accept products on site in factory containers and verify damage
- E. Store products in clean, dry area; maintain temperature to NEMA ICS 1
- F. Maintain temperature above 32°F and below 104°F during and after installation of products
- G. Maintain area free of dirt and dust during and after installation of products
- H. Provide temporary heating and air conditioning units and equipment required to maintain environmental conditions specified for control panel's

3.4 INSTALLATION

- A. Install in accordance with manufacturer's instructions and intent of Contract Drawings. Provide sufficient clearance for calibration and maintenance access
- B. Install control panels, instruments, and motor control centers, to allow a minimum of four (4) feet clearance for access to control devices
- C. Transport, handle, and install products in accordance with manufacturer's instructions
- D. Install on prepared pads at minimum height of 12 inches above grade or floor and not less than 18 inches above flood plain elevation. Anchor securely at each corner. Shim and grout as required to form a watertight seal
- E. Install cabinet fronts plumb
- F. Shop-cut bottom conduit entrance openings for outdoor cabinets. Seal removable plates with silicone sealant. Seal around and beneath perimeter of cabinet with silicone sealant
- G. Install ground rod and equipment ground conductor
- H. Install separate instrument ground lug and ground conductor; connect to common station ground grid.
- I. Mount devices to allow removal and reinstallation without backboard removal. Use stainless steel mounting hardware.
- J. Except for nameplate fasteners, mounting or other hardware shall not penetrate panel exterior.

- K. Exterior Panels: Mount with stainless steel anchor bolts and ground to the station ground field. Install and test ground field to provide maximum 5-ohm resistance to ground in accordance with Section 16452 – “Grounding.”
- L. Provide door restraints for outer and inner doors to positive lock and hold doors open at 115 degrees minimum.
- M. Minimum headroom around control cabinet shall be 78 inches.
- N. Label all wires with heat shrink markers per Section 16052 – “Electrical Identification.”

3.5 CONTROL LOGIC

- A. Lift Station
 - 1. Primary level control shall be a BLUE RIBBON BIRD CAGE TRANSDUCER used in conjunction with a Siemens s71500 PROGRAMMED BY GUZMAN ENGINEERING mounted on pump control panel dead front. All I/O's shall be landed on terminal strips which shall pump down the wet well level using lead/lag and alternation of the lift pumps.
 - 2. The backup level control shall be lead/lag1/lag# level float switches. Where high/low level float switches, when either is activated shall disengage the primary level control and provide alarms to the SCADA cabinet and lift pumps control panel alarm horn and alarm lights.
- B. Provide a start delay timer for each pump, set at 30, 60, and 90 seconds
- C. Each motor controller shall be as follows:
 - 1. Each pump control panel shall be equipped with pull-apart terminal blocks
 - 2. Control wiring and associate control devices in each pump control panel shall be furnished intrinsically safe for operation in its intended environment
 - 3. Provide electronic ambient-compensated overloads for each motor controller. Each overload block shall be wired as indicated. Overload blocks shall be adjustable from 80% to 115% of their nominal value. Where indicated, provide overloads with auxiliary contacts. Selection of overloads shall be determined by the full-load current of motors to be supplied
 - 4. Each motor controller shall be equipped with a copper ground bus
 - 5. All control relays shall be 3-pole ice cube type each with 10-amp, 120V rated contacts. Each contact shall be field convertible. Each relay shall have open-close position indication. Relay coils shall be rated 120V A.C. continuous duty, including the latch type relay coils. Relay to accept #14 AWG conductors

6. Motor branch circuit over current protection shall be motor circuit protectors, unless otherwise indicated. Each "MCP" shall have adjustable current setting pickup. Minimum I.C. of each MCP shall be 22 KA rms symmetrical amps. Motor circuit protectors shall be provided with 120V A.C. shunt trip
7. Controls shall be as indicated on the drawings
8. Remote pilot operators, "RPD" devices, shall be furnished for remote control of indicated motor and other remote-control functions
9. RPD Devices, such as start, stop pushbuttons, pilot lights, and selector switches shall consist of heavy-duty oil-tight operators. Pushbuttons, selector switches, and pilot lights are to be multi-light industrial type. Pilot lights shall be transformer type LED, push to test, complete with LED. Pilot lights shall be equipped with the indicated colored lenses:
 - a. Red: Run
 - b. Green: Stop
 - c. Amber: Fault
 - d. White: Power On
10. Each RPD device shall be equipped with engraved plastic surround to identify functions. Legend plates shall be provided for devices mounted on the door. The plates shall be manufacturer's standard with lettering indicated on the plans and of the same manufacture as the respective pushbutton, selected switch, or pilot light. Provide all legend and name plates as per the plans
11. Remote pilot operators shall be Eaton or Schneider
12. Each motor controller shall have phase failure protection. This device shall sense a loss-of-phase, phase unbalance with negative-sequence sensing circuit, under-voltage, and over-voltage, Furnish Square D type DASV. This device shall be furnished with interlocks to motor control circuits
13. Elapsed time meters shall be installed for each motor and shall measure in increments of hours and be non-resettable. Furnish Eagle Signal Controls H Series time totalizer or approved equal
14. Each pump control panel shall be equipped with a lightning arrester complete with an overcurrent protection device. Furnish schneider or approved equal
15. Each motor controller shall be equipped with a fused control power transformer (CPT). VA capacity of CPT shall be sized to handle its controller load plus external connected loads
16. Each pump control panel shall be furnished with one main disconnect circuit breaker that de-energizes all power and controls when the handle is turned to the off position. Main disconnect shall be able to be padlocked in the off position

3.6 SYSTEM STARTUP

- A. Provide the services of factory trained personnel to assist in the installation and start-up of the control system
- B. Pump controller and pump control panel shall be provided by the pump manufacturer. All devices, switches, indicator lights, etc. shall be installed on the panel dead front

3.7 TRAINING

- A. Provide minimum four (4) hours of “hands-on” instruction each for Owner’s staff. To be conducted at project site by control systems manufacturer’s representative, at no additional cost to Owner. Training is to be conducted after all control systems are fully operational
- B. Provide minimum two (2) weeks’ notice to Engineer and Owner before conducting training

3.8 MAINTENANCE/WARRANTY

- A. Provide manufacturer’s maintenance services of control systems for one year from date of substantial completion
- B. Contractor shall provide full 1-year service warranty on the overall installation and shall include all labor and materials required to repair or replace equipment and/or components that are defective or malfunctioning. Included under this warranty shall be all equipment, devices, hardware, and software. This warranty shall begin on date of written “Final Acceptance” of the electrical systems to be executed as required at no additional cost to the Owner
- C. Contractor’s warranty shall also guarantee 24-hour service response time and shall provide labor, work, or materials as necessary to maintain plant operation when replacement parts are on order. In no case shall plant electrical systems be out of service for more than 24 hours from time Owner calls for warranty service. This shall be provided at no additional cost to the Owner. All equipment and materials installed shall have full warranty from Manufacturer that guarantees equipment is rated for harsh industrial electrical/mechanical environment in which it is installed. Where Manufacturer’s products fail prematurely, Manufacturer shall be fully responsible for new replacement and shall not have the option of declaring that failures were caused by environmental conditions and its effect on the product. Contractor is fully responsible for assuring that Product Manufacturers are aware of this condition and that warranty statement is included in shop drawing submittals. Failure to do so will be at the Contractor’s expense and at no additional cost to the Owner
- D. All critical warranted repairs shall be made within 24 hours of receipt of required parts from Manufacturer with reasonable delivery time of overnight shipping. Any repairs not completed within 5 working days from date of notice are subject to Owner making other arrangements for repair and back

charging contractor. This requirement is a condition of this contract

- E. Where equipment or instrument problems remain unresolved by contractor beyond a reasonable time, a factory technician shall be provided on-site to take any corrective actions necessary to put equipment or instruments in operating order. Owner and engineer reserve the right to determine a reasonable time for corrective action by contractor

END OF SECTION

Section 16438 Panelboards

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. Section Includes: Lighting and power panelboards and associated auxiliary equipment rated 600 V or less

1.2 REFERENCES

- A. A. Institute of Electrical and Electronic Engineers (IEEE):
 - 1. IEEE C62.1 - Standard for Gap Silicon-Carbide Surge Arrestors for AC Power Circuits
- B. IEEE C62.11 - Standard for Metal-Oxide Surge Arrestors for AC Power Circuits
- C. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA PB.1 - Panelboards.
 - 2. NEMA PB1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 volts or less
- D. Underwriter's Laboratory (UL):
 - 1. UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors, 7th Edition
 - 2. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings, 5th Edition

1.3 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051
- B. Product Data:
 - 1. For each type panelboard, accessory item, and component specified.
 - 2. Identification materials.
- C. Shop Drawings:
 - 1. Dimensioned plans, sections, and elevations.
 - 2. Tabulations of installed devices, major features, and voltage rating.
 - 3. Include:
 - a. Enclosure type with details for types other than NEMA Type 1

- D. b. Bus configuration and current ratings.
- E. c. Short circuit current rating of panelboard.
- F. d. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components
- G. Wiring diagrams detailing schematic diagram including control wiring, and differentiating between manufacturer installed and field- installed wiring
- H. Report of field tests and observations in accordance with this section
- I. Maintenance and Operations Data: Include instructions for testing circuit breakers

PART II: PRODUCTS

2.1 MANUFACTURER'S

- A. Schneider
- B. Eaton
- C. General Electric
- D. Or Equal

2.2 PANELBOARDS

- A. Panelboards shall have voltage, overcurrent devices and features as indicated
- B. Breakers shall be bolt-in type, trip-free. Multipole breakers shall be provided with a common internal trip which opens all poles simultaneously and with a single operating handle for all poles. Handle ties between breakers are not acceptable
- C. Breakers for 480V distribution panels shall be rated at least 14000 amps I.C., and breakers for 120/240V panels shall be rated at least 10,000 amps I.C.
- D. Provide copper ground bus inside each cabinet
- E. Enclosures shall be NEMA 4X 316 stainless steel surface mounted cabinet with gasketed, hinged door, inside gutter trim and with door mounted directory pocket.
- F. Electrical panels shall have tinned or silver-plated copper bus
- G. Construction in accordance with NEMA PB1
- H. Overcurrent Protective Devices (OCPD's):
 - 1. Provide type, rating, and features as indicated
 - 2. Tandem circuit breakers shall not be used

- 3. Multi-pole breakers shall have common trip
- I. Enclosures: Cabinets, enclosures, and panels, flush or surface mounted as indicated. NEMA Type 12 enclosure shall be use indoors, except where other enclosure requirements are indicated on drawings. All outdoor enclosures shall be NEMA 4X stainless steel. This includes indoor locations such as wastewater process areas and environmentally harsh locations
- J. Front:
 - 1. Secure to box with concealed trim clamps except as indicated
 - 2. Front for surface mounted panels shall be same dimensions as box
 - 3. Fronts for flush panels shall overlap box except as otherwise specified
- K. Directory Frame: Metal, mounted inside each panel door
- L. Bus: Hard drawn copper of 98 percent conductivity
- M. Main and Neutral Lugs: Mechanical type
- N. Equipment Ground Bus: Adequate for feeder and branch circuit equipment ground conductors. Bonded to box
- O. Service Equipment Approval: Listed for use as service equipment for panelboards having main service disconnect
- P. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices
- Q. Special Features: Provide following features for panelboards as indicated
 - 1. Isolated Equipment Ground Bus: Adequate for branch circuit equipment ground conductors; insulated from box
 - 2. Split Bus: Vertical bus of indicated panels divided into two vertical sections with connections as indicated
 - 3. Extra Gutter Space: Dimensions and arrangement as indicated
 - 4. Auxiliary Gutter: Conform to UL 870
 - 5. Column Type Panelboard Configuration: Narrow cabinet extended as wireway to overhead junction box equipped with ground and neutral terminal buses
 - 6. Sub-feed: OCPD or lug provision as indicated
 - 7. Feed Through Lugs: Sized to accommodate feeders indicated
 - 8. Surge Arresters: For panelboards as indicated on Plans
 - a. Comply with IEEE C62.11 or IEEE C62.1
 - b. Description: Coordinate impulse sparkover voltage with system circuit voltage and provide factory mounting with UL recognized

mounting device

2.3 LOAD CENTERS

- A. Provide load center type panelboards only where specifically indicated
- B. OCPD's: Plugin full module (nominal 1in. width) circuit breaker
- C. Circuit Breakers for Switching Lights at Panelboards: Indicated type SWD
- D. Circuit Breakers for Equipment Marked HCAR Type: Indicated HCAR type
- E. Interiors: Provide physical means to prevent installation of more OCPD's than quantity for which enclosure was listed
- F. Main, Neutral, and Ground Lugs and Buses: Mechanical connectors for conductors

2.4 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

- A. Branch OCPD's: Bolton circuit breakers, replaceable without disturbing adjacent units
- B. Doors: In panel front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike

2.5 DISTRIBUTION PANELBOARDS

- A. Branch Circuit Breakers: Where OCPD's are indicated to be circuit breakers, use bolt on breakers except circuit breakers 225ampere frame size and greater may be plugin type where individual positive locking device requires mechanical release for removal
- B. Doors:
 - 1. In panel front, omit single panelboard door in cabinet front for fusible switch panelboards except as indicated
 - 2. Secure with vault type with tumbler lock, all keyed alike

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: Arranged to permit testing of functions of solid-state trip devices without removal from panelboard
- C. Spare Fuse Cabinet: Identified, compartmented, lockable steel box or cabinet with compartments suitable for surface mounting on wall
- D. All equipment, instruments and devices provided for this project shall have means of protection from power line conditions such as surge, phase fail, or other line conditions that may damage equipment, instruments or devices furnished. It is vendors and manufacturers' responsibility to provide protective devices as required for maintaining warranty of furnished items and to assure no damage occurs from power line conditions

2.7 IDENTIFICATION

- A. General: Provide nameplates for all panelboards.
- B. Panelboard Nameplates: Engraved laminated plastic for each panelboard.

PART III: EXECUTION

3.1 TESTING

- A. Perform tests on low voltage power panelboards and accessories
- B. Upon completing installation of system, perform following tests:
 - 1. Make insulation resistance tests of panelboard buses, components, and connecting supply, feeder, and control circuits
 - 2. Make continuity tests of circuits
- C. Quality Control Program
 - 1. Procedures: Make field tests and inspections and prepare panelboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications
 - 2. Notify Engineer at least one week in advance of testing
 - 3. Report Testing:
 - a. Report written reports of tests and observations
 - b. Report defective materials and workmanship and unsatisfactory test results
 - c. Include records of repairs and adjustments made
 - 4. Protective Device Ratings and Settings:
 - a. Verify indicated ratings and settings to be appropriate for final system configuration and parameters
 - b. Where discrepancies are found, recommend final protective device ratings and settings
 - c. Use accepted ratings or settings to make final system adjustments
- D. Visual and Mechanical Inspection: Include following inspections and related work:
 - 1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up to date drawings and panelboard schedules
 - 2. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction
 - 3. Check panelboard mounting, area clearances, and alignment and fit of components

4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values
 5. Perform visual and mechanical inspection and related work for overcurrent protective devices as within this section
 - E. Electrical tests: Include following items performed in accordance with manufacturer's instruction:
 1. Insulation resistance test of buses and portions of control wiring that disconnected from solid state devices. Insulation resistance less than 100 megohms is not acceptable
 2. Ground resistance test on system and equipment ground connections
 3. Test main and sub-feed overcurrent protective devices in accordance within this section
 - F. Retest: Correct deficiencies identified by tests and observations and provide retesting of panelboards. Verify by system tests that total assembly meets specified requirements
- 3.2 CLEANING
- A. Upon completion of installation, inspect interior and exterior of panelboards
 - B. Remove paint splatters and other spots, dirt, and debris
 - C. Touch up scratches and mars of finish to match original finish
 - D. Clean interior of panelboard
- 3.3 ADJUSTING
- A. Adjust doors and operating mechanisms for free mechanical movement
- 3.4 COMMISSIONING
- A. Balancing Loads: After Substantial Completion, but before Final Acceptance, conduct load balancing measurements and circuit changes as follows:
 1. Perform measurements during period of normal working load as advised by Owner
 2. Perform load balancing circuit changes outside the normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical 24hr services such as Fax machines and online data processing, computing, transmitting, and receiving equipment
 3. Recheck loads after circuit changes during normal load period. Record load readings before and after changes and submit test records
 4. Tolerance: Difference between phase loads exceeding 20 percent at any one panelboard is not acceptable. Re-balance and recheck as required to meet this minimum requirement

3.5 INSTALLATION

- A. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, and manufacturers' written installation instructions, and approved submittals
- B. Mounting Heights: Top of trim 6 ft 2in. above finished floor, except as indicated
- C. Mounting:
 - 1. Plumb and rigid without distortion of box
 - 2. Mount flush panels uniformly flush with wall finish
- D. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing
- E. Install filler plates in unused spaces
- F. Provision for Future Circuits at Flush Panelboards:
 - 1. Stub four 1inch empty conduits from panel into accessible ceiling space or space designated to be ceiling space in future
 - 2. Stub four 1inch empty conduits into raised floor space or below slab other than slabs on grade
- G. Auxiliary Gutter: Install where a panel is tapped to a riser at an intermediate location
- H. Wiring in Panel Gutters: Train conductors neatly in groups, bundle, and wrap with wire ties after completion of load balancing

3.6 GROUNDING

- A. Connections: Make equipment grounding connections for panelboards as indicated
- B. Provide ground continuity to main electrical ground bus indicated

3.7 CONNECTIONS

- A. A. Tighten electrical connectors and terminals, including grounding connections, in
- B. accordance with manufacturer's published torque- tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

END OF SECTION

Section 16441 Pilot & Control Devices

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. This section includes pilot and control devices for instrumentation and control system
- D. Products listed are applicable where shown on plans or required by other specifications or manufacturer's

1.2 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

PART II: PRODUCTS

2.1 TAGGING

- A. Provide Type 316 stainless steel tag on field-mounted units and permanently affix tag to unit
- B. Include Engineer's tag number where listed in Control Diagrams

2.2 PUSHBUTTONS/SELECTOR SWITCH/PILOT LIGHTS

- A. Manufacturers:
 - 1. Square D Class 9001, Type K
 - 2. Eaton
 - 3. Allen Bradley 800T
 - 4. Or, pre-approved equal
- B. Construction:
 - 1. Heavy duty
 - 2. Liquid tight
 - 3. Oil tight
 - 4. Base mounting
 - 5. Flush panel mounting
 - 6. Size to mount in 30.5 mm diameter opening without adapter. Smaller

- units are not acceptable
- 7. Padlock attachments, where required, constructed of metal. Plastic material is not acceptable
- 8. Legend plates, as required, for type of operation or as specified elsewhere
- C. Pushbuttons:
 - 1. Flush head unless specified elsewhere.
 - 2. Contact Blocks:
 - a. Double break silver contacts
 - b. AC Ratings: 7,200 VA make, 720 VA break
 - c. Single pole, double throw or double pole, single throw
 - d. Up to six (6) tandem blocks
 - 3. Maintained contact unless specified elsewhere
 - 4. Non-illuminated.
 - 5. Legend plates, as required, for type of operation or as specified elsewhere
- D. Selector Switches:
 - 1. Maintained position unless specified elsewhere
 - 2. Contact Blocks:
 - a. Double break silver contacts
 - b. AC Rating: 7,200 VA make, 720 VA break
 - c. Single pole, double throw or double pole, single throw
 - d. Up to six (6) tandem blocks
 - 3. Operators:
 - a. a. Number of positions as specified elsewhere
 - b. b. Standard knob type unless specified elsewhere
- E. Pilot Lights:
 - 1. LED, high visibility type
 - 2. Colored lenses as specified elsewhere
 - 3. Interchangeable lenses
 - 4. Push to test
 - 5. Legend plates as specified elsewhere
- F. Enclosures:
 - 1. Mounted in control or instrument panel as specified elsewhere
 - 2. Control Station:

- a. Environment:
 - i. NEMA 12 in general areas
 - ii. NEMA 4X 316 stainless steel in wet locations or outdoors
 - b. Flush or surface mounted as specified elsewhere.
 - i. Provide flush mounted pull box.
 - G. Nameplates:
 - 1. Control Stations:
 - a. Engraved laminated plastic
 - b. Letters 3/16 in. high
 - c. White letters on black background
 - d. Identify per equipment controlled
- 2.3 MOTOR STARTER CONTROL RELAYS**
- A. Manufacturers:
 - 1. Square D
 - 2. Eaton
 - 3. Or pre-approved equal
 - B. Construction:
 - 1. Industrial type
 - 2. 300 V rated
 - 3. AC operation
 - 4. Pressure wire connectors
 - C. Operating Data:
 - 1. Pickup Time: 11 ms maximum
 - 2. Dropout Time: 6 ms maximum
 - D. Coil:
 - 1. Molded construction
 - 2. 120 VAC, 60 Hz
 - 3. Continuous rated
 - 4. Color coded to indicate status
 - 5. Pilot duty
 - 6. 60A make, 6A break, (120 V inductive)
 - E. Contacts:
 - 1. Double break
 - 2. Silver alloy

- 3. Convertible
 - 4. Color coded to indicate status
 - 5. Pilot duty
 - 6. 60A make, 6A break, (120V inductive)
 - F. Track mounting capability
 - G. Accessories:
 - 1. Add-on pole attachment:
 - a. 4 NO and 4 NC contacts
 - b. Add-on to 0 to 4 pole relays
 - 2. Latch attachment.
 - 3. Pneumatic Timer Attachment:
 - a. Single pole, double throw, double break timed contact
 - b. Adjustable 0.2 to 60 sec
 - c. Repeat accuracy of + 15 percent
 - d. Convertible timing mode
 - 4. Transient Timing Mode: Suppress coil transients to 300 V or less
 - H. All relays to be 4PDT type
- 2.4 CONTROL RELAYS
- A. Manufacturers:
 - 1. Potter and Brumfield
 - 2. Struthers Dunn
 - 3. Or pre-approved equal
 - B. Operating Data:
 - 1. Pickup Time: 13 ms maximum
 - 2. Dropout Time: 10 ms maximum.
 - 3. Operating Temperature: -45 o C to 70 o C
 - C. AC Coil:
 - 1. 120 or 240 Va
 - 2. Continuous rated
 - 3. 3.5 VA inrush
 - 4. 1.2 VA sealed
 - 5. 50 to 60 Hz
 - 6. Minimum Dropout Voltage: 10% of coil rated voltage

- D. DC Coil:
 - 1. 24 or 120 Vdc
 - 2. Continuous rated
 - 3. Minimum Coil Resistance
 - a. 24 Vdc: 450 ohm
 - b. 120 Vdc: 9,000 ohm
- E. Contacts:
 - 1. Silver cadmium oxide for 1 amp or less resistive load
 - 2. Gold flashed fine silver; gold diffused
 - 3. 4 Form C
 - 4. 120 VAC
 - 5. 20 amp make, 1.5-amp break (inductive)
- F. Rated at 10 million operations
- G. Plug-in sockets
- H. Enclosed and protected by polycarbonate cover
- I. Provide relay retaining clips
- J. All relays to be 4PDT type

2.5 TIME DELAY RELAY

- A. ATC # 319D-016, with 2 SPDT switches rated 5 amps at 120 Volt, contacts and coil, plug in base and socket, 5 ranges, .02 seconds to 30 minutes.
- B. AGASTAT #7022AC, Instantaneous open on energization, time delay close on de- energization. Time range 1.5 seconds to 15 seconds, 120-volt, 60 Hz
- C. ATC Model #319D-134, with 2 S.P.D.T. switches rated 5 Amps at 120 Volt, contacts and coil, plug in base and socket, 3 ranges, .1 to 100 seconds.
- D. Macromatic Industrial Controls, Model #TAA1U, with two (2) S.P.D.P. switches rated 3 amps at 250-volt contacts, 24-240VAC/DC coil, plug-in base, six (6) functions, sixteen (16) ranges, 0.5 seconds to 10 hours.
- E. Or approved equal

2.6 ELAPSED TIME METER

- A. Manufacturers:
 - 1. Cramer #635G/HRS.
 - 2. Digits: Five (5), non-resettable.
 - 3. Power: 120 VAC, 60 Hz.

- B. Manufacturers:
 - 1. Cramer #635S surface mounted.
 - 2. Digits: Five (5), non-resettable
 - 3. Power: 120 VAC, 60 Hz

2.7 TIMERS

- A. 24 Hour Clock Timer (Repeat Cycle):
 - 1. Manufacturers:
 - a. Tork Time Controls
 - b. Intermatic
 - c. Or pre-approved equal
 - 2. Mounting: Surface
 - 3. Display: 24-hr LCD
 - 4. Contacts: One (1) SPDT rated 20A
 - 5. Set Points: 288 per 24 hr.
 - 6. Skip Feature: 1 to 7-day adjustable
 - 7. Minimum On-Off Time: 5 min.
 - 8. Time cycle programmable by keypad
 - 9. Power: 120 VAC, 60 Hz
- B. Interval/Duration Timer:
 - 1. Manufacturers: ATC or equal.
 - 2. Mounting: Plug-in with dust tight cover
 - 3. Type: Integrated circuit
 - 4. Range: As indicated on drawings
 - 5. Contacts: Two (2) DPDT contacts rated 10 amp
 - 6. Power: 120 VAC, 60 Hz

2.8 ALTERNATOR

- A. Manufacturers:
 - 1. Diversified Electronics:
 - a. Two (2) Pump Duplexor:
 - i. 24 VAC/DC, ARA-24-ABA.
 - ii. 48 VDC, ARA-48-ABA
 - iii. 120 VAC/DC, ARA-120-ABA
 - iv. 208 VAC, ARA-208-ABA
 - v. 240 VAC, ARA-240-ABA

- b. Three (3) Pump Triplexor:
 - i. 24 V, ARA-24-AFE
 - ii. 120 V, ARA-120-AFE
 - c. Four (4) Pump Quadraplexor:
 - i. 24 V, ARA-24-AGE
 - ii. 120 V, ARA-120-AGE
 - d. Two (2)/Three (3) Pump Duplexor/Triplexor: 120 V, ARA-120-AME
 - e. Three (3)/Four (4) Pump Triplexor/Quadraplexor: 120 V, ARA-120-ANE
 - f. Five (5)-Pump Pentaplexor: 120 V, ARP-100
 - g. Six (6)-Pump Hexaplexor: 120 V, ARA-100
 - 2. Time Mark Corporation: 120 V, B 471
 - 3. Macromatic Industrial Controls: Two (2) pump duplexor, 120 volt, ARP120A6, 240 volts, ARP240A6
 - 4. Or approved equal
 - B. Provide automatic alternation of energizing motor starters
 - C. Permit operation of units singly or together as called by pilot devices
 - D. N.O. auxiliary contacts from motor starters required to operate alternator
 - E. Alternator shall provide for operation of standby or lag unit through second pilot device in event of failure of lead unit or first pilot device or alternator coil
 - F. With pump selector switch for operation of two (2), three (3), four (4) and five (5) pump systems
- 2.9 PHASE FAIL RELAY
- A. Diversified Electronics #SLD-440-ALE, 480 Volt, 3 Phase
 - B. Diversified Electronics #SLD-220-ALE, 240 Volt, 3 Phase
 - C. Macromatic Industrial Controls, #PMDU, 208-480 Volt, 3 Phase
- 2.10 ROTATED BEACON
- A. Manufacturers:
 - 1. Edwards: LED 105XBRM Series XTRA-BRITETM LED – RED 120VAC NEMA 4X
- 2.11 EXTERIOR MOUNTED ALARM HORN
- A. Manufacturers:
 - 1. Edwards
 - 2. Or, pre-approved equal
 - B. 120 VAC

- C. Suitable for use in wet location, gasketed.
- D. Cabinet mounted, provide mounting lugs. Body to include outlet box.
- E. Aluminum mounting hood.
- F. ¾ inch conduit hubs

2.12 SUBMERSIBLE PUMP PROTECTION MODULE

- A. Flyght MiniCAS II: Model No. 83 58 57 (24 volt), 40-50 10 98 (120 volt); MiniCAS II/FUS Model No. 14-40 71 13 92 (24 volt)
- B. Module shall be capable of monitoring temperature via a thermal switch embedded in motor winding, and capable of detecting leakage via sensor located in pump
- C. Temperature detection to operate Form "C" 10-amp contact, such that when wired into pump controls will shut down pump when over-temperature condition is detected
- D. Leakage detection to operate Form "C" 10-amp contact, such that when wired into pump controls will initiate alarm
- E. 20-30 VAC, 50-60 Hz with 24-volt external power supply, or 120 VAC, 5-60 control power source
- F. LED indicators for over-temperature and leak indications.
- G. Manual reset pushbutton to interrupt power supply.
- H. Model No. 14-50 70 97 Socket
- I. Temperature Range: 0-50° C (32-123° F), Max 90% RH

2.13 VOLTAGE TRANSDUCER

- A. Manufacturer:
 - 1. Ohio Semitronics, Inc.
 - 2. Or, approved equal
- B. A.C. Voltage Transducer Model VT rated per circuit maximum voltage x 1.25. Select version that matches shown on plans
- C. Transducer to be rated for 125% of current rating

2.14 UNIVERSAL AC CURRENT SENSOR

- A. Manufacturer:
 - 1. Entrelec, SSAC, Inc. – P.O. Box 1000, Baldwin, NY, 13027
 - 2. Or, approved equal
- B. TSC, ECS, ECSH, and ECSL Series: Provides relay contact closure when current reaches pre-set level
- C. Install per Manufacturer's instructions

- D. Sensor to be rated at 125% of current rating

2.15 CURRENT TRANSDUCER

- A. A. Manufacturers:

- 1. HCS

- a. Model: CR4170 Series
- b. Output: 4-20 ma or 0-5 VDC, as required
- c. Three (3) element AC current.
- d. Calibration: True RMS sensing.
- e. Temperature Range: 0 to 50 degrees Celsius.

- 2. NK Technologies

- 3. Ohio Semitronics, Inc.

- 4. Or, approved equal

- B. AT Series: Current transformer with signal conditioner. Split or solid core as applicable. 420 model with 4–20 MA output. Self-powered. 0 – 200-amp range. U.L. listed
- C. A.C. Current Transformer Model No. MCT5, 005E or 005E2 (as shown on plans) with Manufacturer’s recommended CT rated per circuit maximum amps x 1.25
- D. AT/ATR Series: 0 – 200-amp range or, as required by motor current rating
- E. Transducer to be rated for 125% of voltage rating
- F. Size unit to detect peak inrush current of motor

PART III: EXECUTION

3.1 Installation

- A. Install in accordance with manufacturer’s written instructions, applicable requirements of NEC, NECA “Standard of Installation,” and recognized industry practices.
- B. Control Relay:
 - 1. Install panel control relays in I&C panel.
 - 2. Install motor starter control relays in MCC and wherever more rugged type relay required

END OF SECTION

Section 16460 Low-Voltage Transformer

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. General Purpose, Dry Type Transformers.
- D. Drive Isolation Transformers.
- E. Control and Signal Transformers.
- F. Mini Power Zone Packaged Power Supply

1.2 REFERENCES

- A. American National Standards Institute, Inc. /Institute of Electrical and Electronics Engineers (ANSI/IEEE):
 - 1. ANSI/IEEE C2 - National Electrical Safety Code
 - 2. ANSI/IEEE C57.12.80 Standard Terminology for Power and Distribution Transformers
- B. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA LA 1 - Surge Arresters
 - 2. NEMA ST 1 - Specialty Transformers (Except General-Purpose Type)
 - 3. NEMA ST 20 - Dry-Type Transformers for General Applications
- C. Underwriters Laboratories, Inc. (UL):
 - 1. UL 486A- Wire Connectors and Soldering Lugs for Use with Copper Conductors
 - 2. UL 506 – Specialty Transformers

1.3 SUBMITTALS

- A. Product Data:
 - 1. Dimensional plans and sections
 - 2. Elevations showing minimum clearances
 - 3. Installed devices
 - 4. Materials list
 - 5. Weights
 - 6. Wiring diagrams

7. Manufacturer's nameplate data and electrical ratings
- B. Product Test Reports:
 1. Certified copies of manufacturer's design and routine factory tests required by reference standards
 2. Submit after manufacture of transformer and before installation

PART II: PRODUCTS

2.1 MANUFACTURER'S

- A. Square D
- B. General Electric
- C. Or equal

2.2 GENERAL TRANSFORMERS

- A. Transformers:
 1. Factory-assembled and tested, air-cooled units of types specified, having characteristics and ratings as indicated
 2. Design unit for 60 Hz service
- B. Cores: Grain-oriented, non-aging silicon steel
- C. Coils: Continuous windings without splices, except for taps
- D. Internal Coil Connections: Brazed or pressure type
- E. Bolt coil/core to bottom of enclosure for transformers larger than 15 kVA
 1. Isolated by rubber, vibration-absorbing mounts
 2. Metal-to-metal contact between coil/core and enclosure not allowed
- F. Provide copper windings.
- G. Nameplates: Provide metal nameplate listing manufacturer's name, serial number, type, class, kVA voltage, frequency, and showing internal wiring diagram.
- H. Sound Level: Minimum 3 dB less than sound levels for transformer type and size indicated when factory-tested in accordance with NEMA ST 20
- I. Enclosures at wastewater treatment plant outdoor or chemical area locations to be NEMA 4X stainless steel

2.3 DRY-TYPE TRANSFORMERS

- A. Dry-type transformers shall have continuous KVA and voltage characteristics as shown
- B. Enclosures shall be 316 stainless steel
- C. Copper coils shall be provided with NEMA standard taps in high voltage

windings

- D. Furnish Square D or equal dry-type transformers
- E. Comply with NEMA ST 20.
- F. Windings: 2-winding type. 3-phase transformers shall use 1 coil/ phase in primary and secondary
- G. Transformers shall have following features and ratings.
 - 1. Enclosure: Indoor, ventilated unless otherwise shown on plans, outdoor, weatherproof unless shown otherwise on plans
 - 2. Insulation Class: 185 o C or 220 o C class for transformers 15 kVA or smaller; 220 o C class for transformers larger than 15 kVA
 - 3. Insulation Temperature Rise: 80 o C maximum rise above 40 o C for 15 kVA and larger; 115 o C maximum rise above 40 o C below 15 kVA
 - 4. Taps: For transformers 3 kVA and larger, full capacity taps in high voltage winding as follows
 - a. 3 through 10 kVA: Two 5% taps below rated high voltage.
 - b. 15 through 500 kVA: Six 2-1/2% taps, 2 above and 4 below rated high voltage
 - c. 750 through 1,000 kVA: Four 2-1/2% taps, 2 above and 2 below rated high voltage
- H. Accessories: Following accessory items are required where shown on Drawings
 - 1. Surge Arresters: Low voltage type, factory-installed and connected to high voltage terminals; complying with NEMA LA 1
 - 2. Wall Mounting Brackets: Manufacturer's standard brackets for transformers sized up to 75 kVA where wall mounting indicated
 - 3. Electrostatic Shielding: Insulated metallic shield between primary and secondary windings. Connect to terminal marked "shield" for grounding connection, where applicable

2.4 DRIVE ISOLATION TRANSFORMERS

- A. Comply with requirements of NEMA ST 1 and UL 506, except as specified below
- B. Ratings:
 - 1. As indicated and continuous duty
 - 2. Minimum kVA: 130% of motor nameplate hp
- C. Type:
 - 1. Self-cooled, 2-winding, dry type especially designed for application, with special coil bracing to withstand electro-mechanical forces involved

2. 3-ph transformers shall use 1 coil/phase in primary and secondary
- D. Transformers shall have following features and ratings
 1. Enclosure: Indoor, ventilated unless otherwise shown on Drawings
 2. Insulation Class: 220 o C class
 3. Insulation Temperature Rise: 115 o C at 115% of rating
 4. Taps: Two 5% full capacity taps, 1 above and 1 below rated high voltage
 5. Temperature Sensing Device: Thermistor embedded in coil with leads brought out to terminal board
- 2.5 CONTROL AND SIGNAL TRANSFORMERS
 - A. Comply with NEMA ST 1 and UL 506
 - B. Ratings:
 1. As indicated and for continuous duty
 2. Where rating not indicated, provide 250 percent of load
 - C. Type: Self-cooled, 2-winding dry type
 - D. Enclosure: Indoor, except as indicated
- 2.6 MINI POWER ZONE PACKAGED POWER SUPPLY
 - A. Provide with primary breaker, transformer, secondary breaker, and circuit breaker panel as indicated on plans
 - B. Enclosure shall be NEMA 4X for outdoor and wet area indoor use, NEMA 3R for dry outdoor use, NEMA 1 for dry indoor use, and NEMA 12 for dusty indoor use. Provide stainless steel enclosure where shown on plans
 - C. Unit shall be rated for maximum full load temperature rise of 115°C

PART III: EXECUTION

3.1 PREPARATION

- A. Temporary Heating: Comply with manufacturer's written recommendations within enclosure of each transformer throughout periods during which equipment is not in a space continuously under normal control of temperature and humidity

3.2 INSTALLATION

- A. Arrange equipment to provide adequate spacing for cooling air circulation
- B. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values not indicated, use those specified in UL 486A and 486B

- C. Install wall-mounted transformers on prefabricated brackets designed for purpose
- D. Install floor-mounted transformers on 4-in. concrete housekeeping pad
- E. Touch up scratched or marred surfaces to match original finish
- F. Identify transformers as specified herein.
- G. Install lightning arresters as shown on Drawings.

3.3 GROUNDING

- A. Ground in accordance with Section 16452 – “Grounding.”
- B. Ground secondary transformers with separate driven ground rod.

3.4 FIELD QUALITY CONTROL

- A. Test and permanently record as follows.
 - 1. Prior to energization of transformers, test phase-to-phase and phase-to-ground insulation resistance levels
 - 2. Test transformers for continuity of circuits and short-circuits

3.5 ADJUSTING

- A. Adjust transformer taps to provide optimum voltage conditions at utilization equipment

3.6 CLEANING

- A. Upon completion of installation, inspect interiors and exteriors of accessible components
 - 1. Remove paint splatters and other spots, dirt, and construction debris
 - 2. Touch up scratches and mars of finish to match original

END OF SECTION

Section 16710 Network Equipment

PART I: GENERAL

1.1 summary

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. This specification section covers the furnishing and installation of a complete network infrastructure for the PLC SCADA System.
- D. Contractor shall furnish and install all copper, interface devices, network switches, network routers, cabling, distribution and connection panels, mounting racks, mounting brackets, power supplies, controls, and other components of the security network system as shown and specified herein
- E. Contractor shall provide equipment, wiring, and software programming at specified sites as necessary to provide a complete system as described herein and as shown on the drawings
- F. Contractor shall, furnish and install all outlets, junction boxes, conduit, connectors, wiring, and other accessories necessary to complete the system installation
- G. Contractor shall be responsible for providing all equipment and software to achieve the system operability and full functionality described herein
- H. The Contractor shall use the design herein for the implementation of network integration with respect to network hardware
- I. The Contractor shall modify and change the design as required to account for unforeseen network issues and/or to improve the network efficiency
- J. Warning: Electrical systems for this project have lethal voltages present. Contractor shall not work on energized equipment except when absolutely necessary and then only in the presence of another trained, experienced Electrician and with proper protective gear
- K. Installation shall conform to most recent National Electrical Code, International Building Code, and all other referenced Codes shown throughout the specification package.
- L. Plans and diagrams are illustrative and may not contain all devices wiring and controls required to perform the function intended without reference to specifications.
- M. All equipment, conduits, panels, and devices shall be installed in the most strict, professional manner to present a neat installation. Where a question

arises concerning intent of method for installation or where details are not clear, Contractor is to contact the Chief Engineer for clarification before proceeding with work. Any work not suitable or not installed in a professional manner will be modified to an installation acceptable to Chief Engineer at no additional cost.

- N. Substitutions for equipment specified or shown on plans shall be as pre-approved prior to bidding unless specified or shown on plans as "or equal." Where noted as "pre-approved," indicates approval is required prior to bid acceptance.
- O. The work shall include providing materials and equipment required for installation of a complete and functioning communications system as specified and as shown on the drawings.
- P. All plans and specifications for this project are representative of the design intent and may not contain minute details associated with normally accepted communications system construction, as described in applicable codes or as described in manufacturer's literature. Contractor shall provide all appurtenances normally associated with a particular equipment or device, and as required for a proper operating system

1.2 REFERENCES

- A. Refer to section 16050 for additional requirements
- B. Applicable Standards: Comply with the latest editions of the following standards:
 - 1. American IEEE Std 1100, Recommended Practice for Powering Grounding Sensitive Electronics
 - 2. ANSI/EIA/TIA 455 50B, Light Launch Conditions For Long-Length Graded-Index Optical Fiber Spectral Attenuation Measurements
 - 3. TIA/EIA TSB-140, Additional Guidelines for Field-Testing Length, Loss, and Polarity of Optical Fiber Cabling Systems.
 - 4. ANSI/TIA/EIA-455-59A, Measurement of Fiber Point Discontinuities Using an OTDR.
 - 5. ANSI/TIA/EIA 455 60A, Measurement of Fiber or Cable Length Using an OTDR.
 - 6. ANSI/TIA/EIA 455 61A, Measurement of Fiber or Cable Attenuation Using an OTDR.
 - 7. TIA/EIA-526-7, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7
 - 8. TIA/EIA-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – OFSTP-14
 - 9. TIA/EIA-568-B1.1, Commercial Building Telecommunications Cabling

Standard Part 1: General Requirements

10. TIA/EIA-568-B.2-4, Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components
11. TIA/EIA-568-B.3-1, Optical Fiber Cabling Components Standard
12. TIA/EIA-569-A-7, Commercial Building Standard for Telecommunications Pathways and Spaces
13. ANSI/CEA S83-596, Fiber Optic Premises Distribution Cable
14. ANSI/TIA/EIA-526-7,: Optical Power Loss Measurements of Installed Single Mode Fiber Cable Plant-OFSTP-7
15. ANSI/TIA/EIA-526-14-A,: Optical Power Loss Measurements of Installed Multi Mode Fiber Cable Plant-OFSTP-14A
16. ANSI/TIA/EIA-569-A, Commercial Building Standards for Telecommunications Pathways and Spaces.
17. TIA/EIA-598-B, Optical Fiber Cable Color Coding
18. TIA-604-5-C, Intermateability Standard (FOCIS), Type MPO, FOCIS-5
19. TIA/EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure
20. J-STD-607, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
21. TIA/EIA 758, Customer-Outside Plant Telecommunications Cabling Standard.
22. Other applicable Codes and Standards as referenced in other Specifications.
23. Comply with all current local, county, state, and federal regulations and codes in effect.
24. Equipment from foreign manufacture must meet U.S. codes and standards.
25. Equipment and materials shall conform to requirements of specification and to the criteria provided in data sheets for the project.

1.3 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.4 NETWORK INFRASTRUCTURE TECHNICAL REQUIREMENTS

- A. Environment:

1. The system components shall be located in electrical rooms, equipment rooms, suitable equipment enclosures, and suitable NEMA 4X exterior equipment cabinets distributed throughout the various locations. The system components shall be housed in the appropriate equipment

cabinets to meet the specification of the equipment with respect to temperature, and moisture. All enclosures shall suitably house system components with respect to all environmental considerations of the equipment, which are identified on the components specification sheets provided herein

B. Attributes:

1. The system shall comprise network switches and fiber optic and UTP cabling, assembled into fully operating systems as shown on the plans
2. The network switches shall have management software to provide remote configuration and monitoring of the system
3. Switches in outdoor enclosures shall be environmentally hardened and capable of operating from a temperature range of -40 to 140 degrees Fahrenheit
4. Routers in outdoor enclosures shall be environmentally hardened and capable of operating from a temperature range of -40 to 167 degrees Fahrenheit

1.5 PROGRAMMING RELATED ITEMS

- A. A. Provide network infrastructure hardware as shown on the plans and as described herein. The Integration Contractor shall be responsible for providing equipment, installation of equipment, software installation as required, configuration as required, and programming in order to meet the network design scheme
- B. Contractor shall comply with programming allowances designated in bid sheet for this project to be paid to Guzman Engineering, PLLC. upon completion of shop test (50%) and substantial programming completion (100%)
- C. Refer to all sections of this specification and specifications from all disciplines for additional requirements under this contract
- D. General contractor and sub-contractors are not responsible for contents of managed switch configuration where Guzman Engineering Engineers, PLLC. perform the configuration
- E. Warranty for operation of network equipment is solely the responsibility of the programming firm, Guzman Engineering, PLLC
- F. There are to be no contractual agreements between the contractor and/or his sub-contractors and the configuration firm, Guzman Engineering, PLLC
- G. Contractor is required to provide all software required for development of network equipment for this project to programming firm, Guzman Engineering, PLLC. Software shall remain unopened and include all relevant manuals

PART II: PRODUCTS

2.1 GENERAL

- A. Product Acceptability: The products section contains lists of acceptable products. If product substitutions are proposed, they must be made based upon a comparison of equivalent products specified or better. Considerations may include but shall not be limited to functional, physical, environmental, aesthetic and/or interface aspects. Engineer shall be the sole judge of whether or not a submitted substitution is deemed to be “substitutable” to that product which is specified.

2.2 NETWORK EQUIPMENT

- A. Provide network infrastructure hardware as shown on the plans and as described herein. The Integration Contractor shall be responsible for providing equipment, installation of equipment, software installation as required, configuration as required, and programming in order to meet the network design scheme
- B. Local Area Network (LAN) Devices:
1. MOXA
 - a. Local Network Switch: MOXA EDS-P510A Series Layer 2 10-port Managed Switch
 - i. Switch Model Number: MOXA EDS-P510A-8POE-2GTXSFP-T
 - ii. Switch Power Supply (120W) Model Number: DR-120-48
 - iii. 2 Combo Ports (10/100/1000BaseT(X) or 100/1000BaseSFP+)
 - iv. 8 PoE ports (10/100BaseT(X), RJ45 connector)
 - v. Industrial Protocols: EtherNet/IP, Modbus TCP
 - vi. Input Voltage: 48 VDC
 - vii. Operating Voltage: 44 to 57 VDC
 - viii. Input Current: 5.36A @ 48VDC
 - ix. Power Consumption: Max 17.28
 - x. IP Rating: IP30
 - xi. Operating Temperature: -40 to 75 C (-40 to 167 F)
 - xii. Input Voltage: 48 VDC
 - xiii. Optional Copper Transceivers
 - xiv. Optional Fiber Transceiver
 - xv. Warranty Period: 5 years
 2. RED LION
 - a. Local Network Switch: Red Lion SLX-18MG Managed Industrial Ethernet Switch
 - i. Switch Model Number: SLX-18MG-1

- ii. Switch Power Supply Model Number: ET-PS-024-02
- iii. Surge Protector Model Number: SP-ETH-2
- iv. Console Port Cable, DB9 to RJ45: RJ45-DB9F-CBL
- v. 18 Port Gigabit Managed Industrial Ethernet Switch
- vi. 16 (10/100/1000BaseTX RJ-45 Ports)
- vii. 2 (Gigabit SFP (Combo) Ports)
- viii. Operating Temperature: -40 to 75 C
- ix. Redundant Power Inputs: 10 – 30 VDC
- x. Rugged Industrial DIN-Rail Enclosure
- xi. Optional Copper Transceivers
- xii. Optional Fiber Transceiver
- xiii. Warranty Period: 5 years

3. Or approved equal

4. All other equipment shown on plans and required by IT for a full operational network system within the scope of this project.

C. Environment: Components shall comply with manufacturer's environmental specifications

2.3 COMPONENT DESIGN

A. Components utilized in the construction of the material or equipment shall be of the latest proven design, new and in current production. Do not use obsolete components or components to be phased out of production.

PART III: EXECUTION

3.1 PREPARATION

A. Verify dimensions and ratings of equipment and materials to ensure proper fit and performance

3.2 INSTALLATION

A. All equipment to be din rail mounted type

B. Provide and install power supply for network switch with surge protection of each device

C. A. Install equipment and materials in accordance with the Drawings and manufacturer's written instructions

3.3 TESTING AND COMMISSIONING

A. All testing to be performed in compliance with NETA Acceptance Testing Specifications.

B. Test the electrical system to specification requirements and to demonstrate correct installation and operation of equipment.

3.4 CLOSEOUT

- A. Refer to section 16050 for additional requirements

3.5 MAINTENANCE/WARRANTY

- A. Provide extended warranty certificates with contact information to operations and include in Operations & Maintenance manual.
- B. Contractor shall provide full system wide warranty on all equipment for 3-year. Warranty shall include all labor and materials required to repair or replace equipment defective or malfunctioning at no additional cost to owner
- C. Provide any and all testing equipment required to verify equipment malfunction (i.e. power monitor, etc.)
- D. Warranty shall include, but not limited to; equipment, devices, hardware, and software
- E. Warranty begins at time of written acceptance of substantial completion
- F. Provide warranty certificates for electrical installation and consolidate warranty certificates from sub consultants with contact information for repairs
- G. General contractor is ultimately responsible for all warranty items and requests
- H. All repairs shall be made within 24 hours of receipt of required parts from manufacturer with minimum priority shipping. Any repairs not completed within five (5) working days from date of notice are subject to owner hiring separate integrator to perform services. Services shall be invoiced to general contractor

END OF SECTION

Section 16772 Cellular Equipment

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. This section covers cellular modem equipment for wireless communication via cellular carrier service

1.2 SUBMITTALS

- D. Refer to specification for Basic Submittal and O&M Requirements 16051

PART II: PRODUCTS

2.1 MANUFACTURER'S

- A. Cradlepoint
 - 1. COR IBR900-1200M: LTE Advanced Pro 1 Gbps LTE/HSPA+ (Max-09001200-NNA)

2.2 MISCELLANEOUS

- A. Ruggedized enclosure: IP54, Shock/Vibration/Humidity, MIL STD 810G & SAEJ1455
- B. Operating temperature: -22 F to 158 F (-30 C to 70 C)
- C. Cloud managed
- D. Ethernet Ports
 - 1. 2 LAN/WAN switchable 10/100/1000
- E. Required 3G/4G LTE cellular antennas (Qty. 2)
 - 1. Recommended for bench test: 170760-000: Black, Universal 600MHz-6GHz 3G/4G/LTE 2dBi/3dBi 6" antenna with SMA connector (1x)
- F. Required 2.4/5GHz Dual Band WiFi antennas (Qty. 2)
 - 1. Recommended for bench test: 170628-000 Dual-band 2.4/5.0 GHz external WiFi antenna
- G. Required active (powered) GPS antenna
 - 1. Recommended for bench test: 170760-000: Black, Universal 600MHz-6GHz 3G/4G/LTE 2dBi/3dBi 6" antenna with SMA connector (1x)
- H. LTE: Embedded 600 Mbps or 1 Gbps LTE Advanced Pro modem & DC-

- HSPA+ fallback
- I. WIFI: Dual-band, dual-concurrent WIFI; 802.11 a/b/g/n/ac Wave 2
- J. Humidity: 5% - 95%
- K. Voltage: 9 – 33 VDC
- L. Carriers: AT&T, Verizon, T-Mobile, Sprint
- M. Provide router, cards, software, firmware, accessories, and services for Electrical Engineer's use to remotely set-up, monitor, and observe control systems operation
- N. Provide all equipment, devices, accessories, software, firmware, set-up, and programming of Owner's mobile laptop for access to SCADA system via the 3G/4G cellular network
- O. Provide "unlimited" monthly service from Provider. Activation shall be paid for by Contractor until end of 1 – year warranty period of contract, at which time Owner may continue service. Provide a Public Static IP address for each USB modem provided. Service provider shall be coordinated with owner for preferred carrier and account number
- P. Provide range extender and antenna mounted outside of existing building

PART III: EXECUTION

2.3 INSTALLATION

- A. Install in accordance with manufacturer's written instructions, Contract Documents, and approved submittals
- B. Provide cellular service that extends from date controls and/or SCADA systems are activated for testing and programming to end of 1-year warranty period of contract, after which time service contract shall be transferred to Owner
- C. All installation and service costs through this period are at Contractor's expense
- D. Failure to active service at designated time will result in Owner's Representative activating system, and all related costs, including person-hours and overhead, charged to Contractor
- E. Any delay in activation of cellular router system installation will be at Contractor's risk for all testing and engineering schedule changes required
- F. Cellular router shall be activated and coordinated with Engineer and owner prior to any controls inspections or testing by Engineer. Any delay in construction due to this provision is at Contractor's risk

END OF SECTION

Section 16911 Power Monitor

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid
- C. Contractor shall contact local Factory Representative to verify all equipment purchased conforms to the requirements of this project. Failure to do so may result in equipment removal and replacement at Contractor's expense
- D. The Contractor shall furnish and install the Power Monitor equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings

1.2 REFERENCES

- A. General: The latest edition of the following standards and publications shall comply with the work of this section:
 - 1. ANSI/IEEE C12.20
 - 2. National Fire Protection Association, NFPA 70 - National Electrical Code
 - 3. National Electrical Manufacturer's Association
 - 4. ISO 9001, Quality Management Requirements

1.3 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051
- B. Data for each type indicating conductor sizes, conductor types, and connection configuration and lead lengths
- C. Manufacturer's certified test data indicating the ability of the product to meet or exceed requirements of this specification
- D. Drawings, with dimensions, indicating surge protection device mounting arrangement and lead length configuration, and mounting arrangement of any optional remote diagnostic equipment and assemblies
- E. List and detail all protection systems such as fuses, disconnecting means and protective materials
- F. Include installation details demonstrating mechanical and electrical connections to equipment to be monitored.
- G. For side mount mounting applications (device mounted external to electrical assembly), Electrical/Mechanical drawings showing unit dimensions,

weights, installation instruction details, and wiring configuration.

1.4 QUALITY ASSURANCE

A. Manufacturers qualifications

1. Eaton/Cutler Hammer shall be the basis of design. All products submitted shall comply with, meet, or exceed the specifications of the Eaton model type specified herein.
2. Equal products manufactured by Square D Company are acceptable. Equal products as pre-approved are acceptable.
3. The Manufacturer of the assembly shall be the Manufacturer of the major components within the assembly.
4. For the equipment specified herein, the Manufacturer shall be ISO 9001 or 9002 certified.
5. The Manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of 5 years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.5 MANUFACTURER'S

- A. Eaton Cutler-Hammer
- B. Shark Power Meter
- C. GE
- D. Pre-approved equal

1.6 POWER MONITOR

A. Electrical Requirements:

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit

B. Power Monitor Requirements

1. The device shall be capable of monitoring the following with a minimum accuracy of 0.5% of reading:
 - a. Voltage (L-L and L-N)
 - b. Amperes (all phases)
 - c. Watts,Vars,VA
 - d. Power Factor
 - e. Frequency
 - f. Var-Hours, VA-Hours
 - g. Ampere-demand, Watt-demand, VAR-demand, VA-Demand
2. The device shall be capable of monitoring the following advanced parameters with all readings having a minimum accuracy of +/- 0.2%:

- a. Individual Harmonics to the 40th harmonic
- b. Total Harmonic Distortion (Voltage/Current)
- c. Capable of trend logging and analysis up to 100,000 events with timestamp
- d. The device shall be capable of recording the waveform with a minimum of 512 samples per cycle.
- e. The device shall have a current range of at minimum .1-200% of nominal.
- f. The device at a minimum shall have a display capable of 3 lines with 4 characters each, with indication of parameter being displayed.
- g. The device shall be capable of communicating via TCP/IP Ethernet (RJ-45). Route data cable to Ethernet switch. Provide network expansion card as required

1.7 TESTING

- A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards

1.8 PREPERATION

- A. Equipment shall be handled and stored in accordance with Manufacturer's instructions. One (1) copy of Manufacturer's instructions shall be included with the equipment at time of shipment

1.9 INSTALLATION

- A. The Manufacturer shall submit a written statement indicating that a factory technician has inspected the installation. The installing contractor shall submit a checkout memorandum to the manufacturer. The memorandum shall indicate the date the equipment is placed into service and the actual method of installation. Submit three copies to the specifying engineer.
- B. The installation of devices within or on electrical distribution equipment shall in no way compromise or violate equipment listing, labeling, or warranty of the distribution equipment.
- C. The contractor shall follow the Device Manufacturer's recommended installation practice as found in the equipment installation instructions.
- D. The installation shall adhere to all applicable codes.
- E. The Contractor shall install all equipment per the Manufacturer's recommendations and the contract drawings.

1.10 MAINTENANCE/WARRANTY

- A. Contractor shall provide full 5-year service warranty on the overall installation and shall include all labor and materials required to repair or replace equipment and/or components that are defective or malfunctioning.

- B. Included under this warranty shall be all equipment, devices, hardware, and software. This warranty shall begin on date of written "Final Acceptance" of the electrical systems and to be executed as required at no additional cost to the Owner. Contractor's warranty shall also guarantee 24-hour service response time and shall provide labor, work, or materials as necessary to maintain plant operation when replacement parts are on order. In no case shall plant electrical systems be out of service for more than 24 hours from time Owner calls for warranty service. This shall be provided at no additional cost to the Owner. All equipment and materials installed shall have full warranty from Manufacturer that guarantees equipment is rated for harsh industrial electrical/mechanical environment in which it is installed. Where Manufacturer's products fail prematurely, Manufacturer shall be fully responsible for new replacement and shall not have the option of declaring that failures were caused by environmental conditions and its effect on the product.
- C. Contractor is fully responsible for assuring that Product Manufacturers are aware of this condition and that warranty statement is included in shop drawing submittals. Failure to do so will be at the Contractor's expense and at no additional cost to the Owner.
- D. All critical warranted repairs shall be made within 24 hours of receipt of required parts from Manufacturer with reasonable delivery time of overnight shipping. Any repairs not completed within 5 working days from date of notice are subject to Owner making other arrangements for repair and back charging Contractor. This requirement is a condition of this contract.
- E. Where equipment or instrument problems remain unresolved by Contractor beyond a reasonable time, a Factory Technician shall be provided on-site to take any corrective actions necessary to put equipment or instruments in operating order. Owner and Engineer reserve the right to determine a reasonable time for corrective action by Contractor.

END OF SECTION

Section 16950

PLC/SCADA Equipment

PART I: GENERAL

1.1 SUMMARY

- A. This specification is confidentially issued for this specific project only.
- B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid.
- C. The documents shall not be used as a basis for additional compensation due to omission of details of other sections, specifications, documents, and drawings.
- D. Furnish all work, labor, tools, staff, material, equipment, and operations necessary to provide and install a complete and functioning electrical system as defined in construction documents.
- E. Any equipment, devices, or software required that may be overlooked by engineer or owner's representative shall not absolve responsibility of contractor to provide required equipment or software at no additional cost to owner.
- F. It is the intent of the contract document that upon completion of the scope of work, the entire system shall be a finished/workable condition.
- G. Major scope of work:
 - 1. All work necessary for a fully operational SCADA operating system.
 - 2. All field testing, shop testing, startup, calibration, adjustment, development of all HMI screens, and all requested automation logic programming required by the contract documents.
 - 3. Additional automation logic programming and HMI screen development may be requested by the authority or owner's representative. This development shall be included at no additional cost to the owner.
 - 4. Full programming of automation logic of all programmable logic controllers, personal computers, servers, historians, laptop computers, human machine interface (HMI), and all other equipment tied into SCADA system.
 - 5. All equipment with registers or address utilized by the PLC requiring modification shall be included in the overall scope of work. Not only new equipment is included in scope of work, existing equipment/SCADA systems may require programming to access into the new system. These modifications and coordination fall into the overall scope.
 - 6. All development and operating software shall be included in contractors' scope of work and shall be provided unsealed and with all

licenses, keys, access codes, and required drivers.

7. Coordination with all communication equipment manufacturers including radio, fiber optic, telephone, and data lines required for compatibility and a fully operational SCADA system. All hardware and software shall be included for communication equipment relevant to SCADA System in overall scope of work.
8. Testing of all SCADA systems in conjunction with communication system prior to full startup with stakeholders and inspections.
9. Provide and install all hardware and software required per construction documents and authority standards/requests.
10. Delivery, certification, calibration, adjustment, testing, startup, and recalibration of entire SCADA system.
11. Full 1 – year warranty on entire installation and programming with warranty certificates. Provide separate warranty certificates as required for control panel fabricated equipment and programming of system.
12. Provide full surge protection for all devices.
13. Provide full power quality protection for all devices.
14. Redundant 4-hour UPS power supplies
15. Provide any and all required equipment to comply with warranty certificates.
16. Provide grounding system per NEC Article 250, construction drawings, and technical specifications.

H. High level system requirements:

1. The controller system shall monitor and control the equipment functions stated in the construction documents. Functional requirements shall be coordinated with authority, all manufacturers, and integrators from all disciplines. Lack of coordination that leads to missing equipment and/or services out of scope shall not be used for change order of services. Any additional scope due to lack of coordination shall be at no expense to owner.
2. Under this contract, contractor shall interconnect and setup all systems for full SCADA system.
3. Controls shall operate from a source of 120VAC, 1 phase, 60 Hz UPS.
4. All equipment shall be protected from lighting and other transient voltage events with surge protection devices sized as appropriate. Communication equipment shall be protected from transient events with surge protection devices.
5. Provide condensation protection for panels without climate control. Enclosures shall include continuously operated heaters with thermostats to prevent condensation. Thermostat level shall be

coordinated with equipment manufacturer of most sensitive item by a factor of .9 of min/max rating.

1.2 REFERENCES

- A. Installations shall conform to all appropriate articles/sections of latest standards, codes, local codes, and ordinances of the owner, authority having jurisdiction, and all entities involved. Contractor shall be responsible for verifying relevance of each reference requirement per the project scope, appropriateness, owner input, and historical requirements. Contractor may submit questions on code requirements where legitimate conflict exists. Relevant references may include all shown below:
 - 1. National Electrical Code (NEC)
 - 2. Underwriters Laboratories (UL)
 - 3. National Electrical Manufacturers Association (NEMA)
 - 4. Insulated Power Cable Engineers Association (ICEA)
 - 5. International Building Code (IBC)
 - 6. National Fire Protection Association (NFPA) 70E – “Standards for safety in the work place”
 - 7. American National Standard Institute (ANSI)
 - 8. Institute of Electrical and Electronic Engineers (IEEE)
 - 9. International Energy Conservation Code (IECC)
 - 10. Texas Center for Environmental Quality (TCEQ)
- B. Where contract documents indicate requirements, which are in excess of minimum requirements stated in section 1.03 (A), the most stringent requirements shall be met. Should there be any conflicts between the contract documents and section 1.03 (A), submit RFI's prior to bid.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 - 1. Contractor is bound to coordinate all equipment and scope of work with engineers and sub-contractors under this contract. Coordination of various equipment installations and operations is required as not to delay scheduled installation and startup.
 - 2. Refer to contractor responsibilities section of this document for further coordination items.
- B. Preinstallation meetings
 - 1. Should contractor require a pre-installation meeting for any equipment with engineer, contractor shall provide ample time to schedule all required parties.

- C. Scheduling
 - 1. Provide schedule of construction to engineer for review on a monthly basis. Refer to submittal section for further requirements.

1.4 SUBMITTALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051
- B. The owner, authority, and engineer shall review full SCADA system technical information for compliance with construction documents.
- C. Contractor to submit the following items with each submittal as appropriate:
 - 1. Shop drawings
 - 2. Data sheets
 - 3. Wiring diagrams
 - 4. Installation sketches
 - 5. Warranties
 - 6. Testing report documentation
 - 7. Bill of materials
 - 8. Catalog cut sheets
 - 9. General descriptive information
 - 10. Highlighted or boxed catalog numbers and add-ons
 - 11. Relevant specification marked comply, exception, or approved equal
- D. Provide the following submittals as part of this specification for review:
 - 1. Wiring devices
 - 2. Block diagrams
 - 3. SCADA system
 - 4. Surge protection devices
 - 5. Control cabinet enclosures
 - 6. Control cabinet wiring and terminal blocks
 - 7. Control cabinet devices and nameplates
 - 8. Control panels
 - 9. Vendor furnished equipment
 - 10. Nameplate designations
 - 11. Programming narratives
 - 12. Bill of materials
 - 13. Development software

- 14. Operational software
- 15. Project schedule on a monthly basis
- 16. Training schedule
- 17. Training manual document
- 18. Warranty certificates
- 19. Testing reports
- 20. PLC and other equipment updated credentials for administrative rights.

1.5 OPERATIONS & MAINTENANCE MANUALS

- A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.6 CONTRACTOR QUALIFICATIONS

- A. Contractor, panel manufacturer, and programmer may be required to submit a statement of qualifications to the engineer prior or post bid. Qualifications statement shall show proof of similar plant installations for not less than four (4) recent projects in the region. Provide name of project, owner, address, and contact information for verification of qualifications.
- B. Failure to meet acceptable qualifications may lead to disqualification to perform services on this project.
- C. All staff assigned to the project shall be full time qualified employees. Contract type employees shall not perform services on this project unless preapproved by engineer. Contractor shall provide proof of experience and employment where requested by owner, engineer, or their representatives.

1.7 SPARE PARTS

- A. Spare parts shall be hand delivered to operations team at 75% completion of project completion to operations team.
- B. Furnish, tag, and box all spare parts in an organized manner. Provide detailed bill of materials of all items included in box.
- C. Provide transmittal form documenting individuals delivering and receiving spare parts with date, signature, printed name, and title. Provide scanned copy to engineer for record keeping. Include documents in O&M manual.

1.8 PROGRAMMING RELATED ITEMS

- A. Contractor shall comply with programming allowances designated in bid sheet for this project to be paid to Guzman Engineering upon completion of shop test (50%) and substantial programming completion (100%).
- B. Refer to all sections of this specification and specifications from all disciplines for additional requirements under this contract.
- C. General contractor and sub-contractors are not responsible for contents of program where Guzman Engineering perform the programming.
- D. Warranty for operation of program is solely the responsibility of the

programming firm, Guzman Engineering.

- E. There are to be no contractual agreements between the contractor and/or his sub-contractors and the programming firm, Guzman Engineering.
- F. Contractor is required to provide all software required for development and operation of Programmable Logic Controller (PLC) automation logic, Human Machine Interface (HMI), communication system, Distributed Control Systems (DCS), Industrial Control System (ICS), Supervisory Control and Data Acquisition System (SCADA), network equipment, alarm system, and all other systems required for this project to programming firm, Guzman Engineering. Software shall remain unopened with all applicable licenses provided in a secure fashion.
- G. Programming period:
 - 1. Allow a minimum of 20 working days for uploading and testing of program.
 - 2. Provide 4 weeks of advance notice for scheduling of program uploading and testing.
 - 3. Lack of scheduling shall not absolve contractor of scheduling restrictions and associated fees for delay.

PART II: PRODUCTS

2.1 GENERAL

- A. The functions and features specified in the contract documents are minimum requirements for the overall system. The system shall be equal or exceed requirements.
- B. All equipment required under this contract shall be provided and installed, including all appurtenant items not mentioned in documents.
- C. All equipment shall be new, unused, and purchased for this project.
- D. Provide all like equipment from a single manufacturer where available unless stated otherwise in construction documents. Major equipment such as SCADA system and electrical system do not need to have a single manufacturer provide all equipment.
- E. Provide all required I/O modules, communication modules, and equipment required for a fully functional SCADA system. Provide I/O modules required for all terminated signals plus (+) 25% additional spare ports based on total terminated signal cables.
- F. All interconnect cables and connectors for controller shall be factory manufactured and/or assembled.
- G. All overcurrent protection shall be circuit breaker type, fuses are not allowed.
- H. PLC equipment shall not be installed on outer door of control panel with

exception of HMI's.

2.2 PROGRAMMABLE LOGIC CONTROLLER (PLC) – SIEMENS S7-1515

A. CPU

1. 1515C

B. Communications

1. Two (2) RJ45 ethernet ports
2. Eight (8) port managed network switch with (2) minimum SFP ports for fiber communications
 - i. Cisco
 - ii. MOXA
 - iii. Siemens RuggedCom
3. Integrated Program Memory: 500KB
4. Integrated Data Memory: 3 MB
5. Address area: 32 KB In/ 32 KB Out
6. Execution time: 30 nanoseconds
7. Display: Included in CPU
8. Storage memory: Simatic Memory Card, Min. 12 MB

C. Power Supply

1. 85 – 256 VAC, 1 phase, 47 – 63 Hz
2. 108 – 132 VDC
3. 16.8 – 31.2 VDC
4. Sufficient power to feed CPU and all required connected modules
5. Automatic safe shutdown capabilities under power loss or overvoltage
6. Surge protection capabilities
7. Diagnostic capabilities
8. Failsafe fuse not accessible by customer
9. Additional power supplies as required to power all connected modules

D. Input/Output Modules

1. Circuit breaker overcurrent protection
2. Modular plugin type to mounting base
3. LED indicator for status, health, and communication
4. 16 points per discrete input module
5. 16 points per discrete output module

6. 2.5 amp maximum per discrete output module point
7. 16 amp maximum per discrete output module
8. 4 – 20 mA analog input/output range
9. 16 bits across range resolution for analog input points
10. Provide and install isolators and surge suppression devices as specified or recommended by manufacturer
11. 8 points per analog input module
12. 12 bits across range resolution for analog output points
13. Calibration accuracy of analog outputs: better than 0.1% of range from 4 – 20 mA
14. 8 points per analog output module

2.3 HMI

- A. Maple Systems Model HMI5104TH Series 10-inch color touch screen
 1. Intel Core i3 7101TE
 2. 3.4 Ghz
 3. 8 GB DDR4 RAM
 4. 256 GB Hard Drive
 5. Windows 11 Pro (Embedded)
 6. Provide Third party Modbus compatibility
 7. Provide 1 gigabyte flash drive
 8. Provide 1 gigabyte spare flash drive
 9. Provide VTScada 12.2 HMI/SCADA Runtime Package software for all sites except lift stations unless otherwise noted.
 - a. HMI/SCADA for Desktop/Server (5,000 tags) – (VTScada 12.2)
 - i. Coordinate with owner and operations for compatibility into existing Scada network. Provide version as required for integration.
 10. One (1) ethernet 10/100 Mbps minimum for communications
 11. One (1) serial RS-232 port for communications
 12. Two (2) minimum USB ports
- B. Maple Systems Model PC2315B 15-inch industrial panel PC
 1. Intel Core i3 7101TE
 2. 3.4 Ghz
 3. 8 GB DDR4 RAM

4. 256 GB Hard Drive
5. Windows 11 Pro (Embedded)
6. Provide VTScada 12.2 HMI/SCADA Runtime Package software for all sites except lift stations.
 - a. HMI/SCADA for Desktop/Server (5,000 tags) – (12.2)
7. One (1) ethernet 10/100 Mbps minimum for communications
8. One (1) serial RS-232 port for communications
9. Two (2) minimum USB ports

2.4 CONTROLLER

- A. Manufacturer: Rosemount
- B. Model #: 1056
- C. Operating Temperature: -20 C – 60 C (-4 to 140 F)
- D. Relative Humidity: 95%
- E. Enclosure: NEMA 4X/IP66 metal
- F. Power:
 1. AC powered 100 – 240 VAC +- 10%, 50/60 Hz
 2. 24VDC – 15%
- G. Communication:
 1. Outputs: (2) 4 – 20 mA or 0 – 20 mA DC isolated outputs. Fully scalable
 2. Output accuracy: + or - .05mA at 25 C
- H. Various
 1. Two (2) analog (0 – 20 mA or 4 – 20 mA) outputs. Each analog output can be assigned to represent a measured parameter.
 2. Display: monochromatic graphic liquid crystal display
 3. Conduit openings: accepts 1/2" of pg13.5 conduit fittings
 4. Ambient Temperature: 0 – 55 C
 5. Power: 115/230 VAC
 6. Alarms: four (4) configurable alarms for process measurements and temperatures. Each relay configurable independently and with internal timing settings
 7. Inputs: two isolated sensor inputs
 8. Outputs: Two (2) 4 – 20 mA DC or 0 – 20 mA DC isolated outputs. Fully scalable.

9. Output accuracy: + or - .05 mA at 25 C

2.5 UPS, PS, LOOP ISOLATION

- A. Switching type battery supplies are not acceptable.
- B. Route fail output relay to PLC for UPS fail alarm.
- C. Mean Well SP-200-24 Power Supply
 1. Input Voltage: 110
 2. Output Voltage: 24
 3. Units: V DC
 4. Various:
 - a. DC Voltage: 24 VDC output
 - b. Current range: greater than or equal to 8 – amps
 - c. Rated power: greater than or equal to 200 watts
 - d. Voltage adjust range: 22V – 26.4 V
 - e. Frequency range: 47 – 63 Hz
 - f. Efficiency: 85%
- D. APC Smart SRT 1500RM XLA/SRT150 0RMXLA NC UPS
 1. Input Voltage: 110
 2. Output Voltage 120
 3. Units: V DC
 4. Communication: Ethernet
 5. Various
 - a. 2-hour runtime on full load
 - b. Automatic reset after power is restored to UPS
- E. Acromag 651T Loop Isolator
 1. Input: 4
 2. Output: 20
 3. Units: mA
 4. Communication: 4 – 20 mA
 5. Various:
 - a. Isolation: Inputs, outputs, and channels are isolated from each other for common-mode voltage up to 25VAC, or 354VDC off DC power ground, on a continuous basis
 - b. Noise rejection common mode: 100dB at 60 Hz
 - c. Normal mode: -5dB at 60 Hz, 100-ohm source
 - d. Input bandwidth: -3dB at 45 Hz with 500 ohm load

2.6 SOFTWARE

- A. Provide costs in bid for all licensed complete development and operation software required for to program entire SCADA System
- B. Provide and furnish all hardware (cables, adapters, etc.) for connection to PLC for development and operation.
- C. All software shall be turned over to owner upon substantial complete for future modification, documentation, and development along with associated passwords. Contractor shall maintain license keys and information for a period of 5-years should owner require information at a future date. Failure to maintain records may require contractor to refurnish software. Signed transmittal forms are recommended in order to document exchange of software equipment, license, passwords, and all other relevant information to protect contractor from refurnishing equipment.
- D. All software shall be Microsoft Windows based
- E. All manufacturer set default passwords shall be reset and credentials shall be provided to engineer for internal documentation.

2.7 SOURCE QUALITY CONTROL

- A. Manufacturer to provide guidance and coordination on entire installation of equipment in order to follow all manufacturer recommended procedures. Manufacturer shall be put on contract for on site inspection as required by engineer at no additional cost to owner. Include cost in bid.
- B. Operations team shall be consulted upon completion of programming for satisfactory inspection of all developed screens, trends, and automation logic prior to on site startup with owner's representative and engineer.

PART III: EXECUTION

3.1 GENERAL

- A. All signals up to point of PLC terminals shall be tested for accuracy. Replace labels as required once testing has been completed.

3.2 TESTING

- A. All equipment shall put through a trial run-in test to ascertain the performance complies with the intent of the specifications. All-in tests shall be made in the presence of the Engineer and owner's representatives.
- B. Startup testing shall be performed prior to testing in presence of owner's representative and engineer.
- C. Perform all factory test, field tests, and startup tests.
- D. Engineer may request inspection prior to upload of program.

3.3 PREPERATION

- E. Allow adequate time for coordination, long lead time item orders, programming, and testing under this contract.
- F. Mobilization and demobilization time shall be taken into account in overall construction schedule and delays shall be considered into scheduling contingencies.

3.4 INSTALLATION

- A. Programmable Logic Controller (PLC)
 - 1. Tie into rugged managed network switch
 - 2. Mounted on din-rail on panel backplane
- B. Human Machine Interface (HMI)
 - 1. Tie into rugged managed network switch
 - 2. Mounted on din-rail on panel backplane
- C. Labeling
 - 1. In addition to requirements for labeling as specified throughout this section, install as follows:
 - a. Phase color insulation is required for all conductors, no exceptions.
 - b. Apply numbered wire marking labels to control wires; power wiring in panelboards, pull and junction boxes, and at outlets to identify circuit numbers. Each control wire shall be labeled at each connection. Labels shall heat shrink type.
 - c. Apply Phenolic labels with engraved identification to wiring sets in each hand-hole to identify function. Use waterproof labels.
 - d. Apply write-on identification labels to empty conduits to identify each with information as to terminus of other end and also trade size of conduit.
 - e. Install micarta nameplates with engraving to identify function and/or load served for the following:
 - i. Panelboards
 - ii. Overcurrent Devices
 - iii. Power Quality Monitor
 - iv. Control Panels
 - v. Automatic Transfer Switch
 - vi. Wet Well Junction Box
 - vii. All components in control panel and SCADA panel
 - f. Micarta nameplates shall be attached with aluminum rivets, use two (2) per each nameplate.
 - g. Submit for review a schedule for engraving along with size for each proposed micarta nameplate. Do not fabricate nameplate until review has been completed.

- h. Type circuit directory information on circuit directory cards on all panelboards and laminate.

3.5 SYSTEM STARTUP

- A. Upon successful testing, contractor shall provide full system startup in presence of authority, owner's representative, and engineer presenting fully functional gate operating system with all respective capabilities
- B. Contractor is responsible for coordinating with all parties required for system startup including manufacturer's prior to system startup. Ample time is required for coordination.
- C. System will be not be accepted by owner until all systems are started and presented to authority, owner's representative, and engineer without issues or pending punch list items
- D. Provide the services of factory trained personnel to assist in the installation and start- up of the control system. Pump controller and pump control panel shall be provided by the pump manufacturer. All devices, switches, indicator lights, etc. shall be installed on the panel dead front

3.6 ADJUSTEMENT/CALIBRATION

- A. Should initial testing or system startup not present an acceptable functioning system, adjustment/calibration shall be performed as necessary at no additional cost to owner.

3.7 CLEANING

- A. Remove all temporary labels, dirt, paint, grease and stains from all exposed equipment. Upon completion of work, clean equipment and entire installation site in a workmanlike manner. No loose parts or scraps or equipment shall be left on the premises. Site shall not be accepted by owner where site is not suitably cleaned to engineer or owner's representative preference.
- B. Equipment paint scars shall be repaired with paint kits supplied by the equipment manufacturer, or with an approved paint.
- C. Clean interiors of each item of electrical equipment. At completion of work all equipment interiors shall be free from dust, dirt, and debris.

3.8 Training

- A. A full training program for all equipment shall be provided by contractor and programming integrator.
- B. Manufacturer may be utilized to perform training. Include any costs for training into bid for no additional cost to owner during construction.
- C. The training shall consist of minimum (2) 8-hour days with operations team.
- D. Submit training program schedule to engineer for review.
- E. Engineer may attend training with operations.

- F. Program shall include:
 - 1. Familiarization of all equipment
 - 2. Utilization of installed system
 - 3. Maintenance training
 - 4. Frequently common maintenance items
 - 5. High level screen development overview
 - 6. Deliverable training manual document. Submit to engineer for review.

3.9 CLOSEOUT

- A. Substantial completion shall occur only when the below items have been submitted, accepted, and approved.
 - 1. Submittals
 - 2. O&M Manuals
 - 3. Contractor testing
 - 4. Inspections
 - 5. Operations team training
 - 6. Warranty certificates
 - 7. Shop testing
 - 8. Record drawings
 - 9. Spare parts

3.10 MAINTENANCE/WARRANTY

- A. Provide extended warranty certificates with contact information to operations and include in Operations & Maintenance manual.
- B. Complete and all-inclusive warranty shall be for three (3) years from substantial completion.
- C. 24-hour service response time
- D. Provide all labor, work, equipment, and materials required at no additional cost to owner.
- E. Full replacement of prematurely failed equipment.
- F. Where contractor does not repair failures within five (5) working days, owner may put separate integrator under contract to mitigate failures with invoice for labor to be paid by contractor. General contractor shall coordinate this service warranty with sub-contractor. Qualifications for this service shall be the sole responsibility of the general contractor at no additional cost to owner.

END OF SECTION