

City of Friendswood

ENGINEERING DEPARTMENT



TM

PROJECT MANUAL FOR
2020 LIFT STATION MITIGATIONS PACKAGE 4 –
LIFT STATION 4 CONSTRUCTION SERVICES

PROJECT No.: LS004 MIT

BID No.: 2026-04

Divisions 00 through 16

ISSUED: MARCH 2026

5ENGINEERING, LLC
11200 WESTHEIMER ROAD, SUITE 353
HOUSTON, TX 77042
(832) 800-3483



03/05/2026

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>Project Manual Cover</i>	00001
<i>Table of Contents</i>	00005

RFQ / RFP / ITB PROCESS

<i>Invitation to Bid (Federal Funds)</i>	00105
<i>Insurance Requirements</i>	00130
<i>Child Support Affidavit</i>	00135
<i>Bidder’s Bond</i>	00140
<i>Unit Price Bid Form</i>	00145
<i>Post-Bid Procedures</i>	00160

CONTRACTING REQUIREMENTS

<i>Standard Agreement for Contracting Services</i>	00230
<i>Texas Workers Compensation</i>	00245
<i>Wage Scale</i>	00250
<i>Affidavit of Insurance</i>	00255
<i>Alcohol and Drug Free Workplace Policy</i>	00260
<i>Construction Storm Preparation Policy</i>	00265
<i>Hazardous Communications Program Requirement Agreement</i>	00270
<i>Homeland Security Policy</i>	00275
<i>Texas Ethics Commission Form 1295</i>	00280
<i>Performance Bond</i>	00285
<i>Payment Bond</i>	00290
<i>Vendor Information Packet</i>	00295

<u>DOCUMENT TITLE</u>	<u>SECTION</u>
<i>General Conditions</i>	<i>00300</i>
<i>Supplementary Conditions</i>	<i>00305</i>

CLOSEOUT

Affidavit of Payment to Subcontractors and Suppliers	00610
Contractor's Certification of Final Completion	00615
One-Year Maintenance Bond	00625

DIVISION 01 – GENERAL REQUIREMENTS

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

DIVISION 02 – SITE WORK

EROSION CONTROL

Erosion Control Systems	02000
Filter Fabric Silt Fence	02005
Straw Bale Fence	02010
Geotextile	02015
Stabilized Construction Access, Roads, Parking and Wash Areas	02020
Water-Permeable Sediment Filtration	02025

<u>DOCUMENT TITLE</u>	<u>SECTION</u>

Rock Filter Dams	02030

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

DOCUMENT TITLE

SECTION

POTABLE WATER SYSTEMS

Water Lines	02400
Butterfly Valves	02405
Gate Valves	02410
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

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

DOCUMENT TITLE

SECTION

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

<u>DOCUMENT TITLE</u>	<u>SECTION</u>
DIVISION 03 – CONCRETE	
Mortar	03000
Grout	03005
Reinforcing Steel	03010
Structural Concrete.....	03015
DIVISION 04 – MASONRY	
DIVISION 05 – METALS	
<i>Metal Fabrications</i>	<i>05501</i>
DIVISION 06 – WOOD AND PLASTICS	
DIVISION 07 – THERMAL AND MOISTURE PROTECTION	
DIVISION 08 – DOORS AND WINDOWS	
DIVISION 09 – FINISHES	
<i>Protective Coatings.....</i>	<i>09901</i>
DIVISION 10 – SPECIALTIES	
DIVISION 11 – EQUIPMENT	
DIVISION 12 – FURNISHINGS	
DIVISION 13 – SPECIAL CONSTRUCTION	
<i>Process Controls Systems – General Provisions.....</i>	<i>13300</i>
<i>Process Control System Testing</i>	<i>13302</i>
<i>Process Control System Training</i>	<i>13303</i>
<i>Applications Engineering Services.....</i>	<i>13306</i>
<i>Control Panel Enclosure and Panel Equipment.....</i>	<i>13330</i>
<i>Control Panel Uninterruptible Power Supply (Single Phase)</i>	<i>13335</i>
<i>Process Control Instruments</i>	<i>13340</i>
<i>Control Loop Descriptions</i>	<i>13400</i>
DIVISION 14 – CONVEYING SYSTEMS	
DIVISION 15 – MECHANICAL	

DIVISION 16 – ELECTRICAL

<i>Basic Electrical Requirements</i>	16010
<i>Electrical Support Hardware.....</i>	16045
<i>Electrical Demolition</i>	16060
<i>Power System Study.....</i>	16105
<i>Raceway Boxes Enclosure and Fittings</i>	16110
<i>Low-Voltage Wires and Cables</i>	16120
<i>Light Switches and Receptacles</i>	16140
<i>Electrical Identification</i>	16195
<i>Low Voltage AC Surge Protective Device</i>	16197
<i>Automatic Transfer Switch</i>	16220
<i>Distribution Dry-Type Transformers.....</i>	16461
<i>Panelboards</i>	16470
<i>Low Voltage Enclosed Circuit Breakers and Disconnect Switches.....</i>	16475
<i>Motor Controllers</i>	16481
<i>Underground System</i>	16600
<i>Grounding and Bonding System.....</i>	16660
<i>Standby Natural Gas Engine Generator</i>	16661

END OF SECTION

CITY OF FRIENDSWOOD INVITATION TO BID



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2020 LIFT STATION MITIGATIONS PACKAGE 4 - LIFT STATION 4 CONSTRUCTION SERVICES ITB #2026-04

Bidding forms, 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 bids plainly marked **Bid #2026-04 2020 Lift Station Mitigation Package 4 - Lift Station 4 Construction Services** 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., Tuesday, April 7, 2026**, at which time there will be a public bid opening. Bid submittals will be accepted at the address listed above or electronically via www.civcastusa.com.

The City of Friendswood (the "City") reserves the right to reject any or all bids and to waive any informality in the bids received. The contract, if any, will be awarded to the lowest responsible bidder. The City pays for goods and services according to the provisions of Chapter 2251 of the Government Code.

Specifications and related information may be downloaded from www.civcast.com, the

00105-1

City's website at <https://www.ci.friendswood.tx.us/Bids.aspx> or may be reviewed/inspected during regular business hours in the City Secretary's Office, City Hall, 910 South Friendswood Drive, Friendswood, TX 77546.

A bid guarantee in the form of a bidder's bond, certified check or a cashier's check made out to "City of Friendswood" in an amount equal to five percent (5%) of the greatest amount bid must accompany each submission. **BIDS THAT DO NOT HAVE THE ACCOMPANYING BID GUARANTEE WILL BE RETURNED TO THE BIDDER.**

For contracts in excess of \$50,000, payment, performance, and maintenance bonds along with a bid guarantee are required by the City.

A **Non-Mandatory Pre-Bid Conference and Site Visit** is scheduled for **March 24, 2026, at 10:00 A.M** at the Friendswood City Hall, 910 S. Friendswood Drive, Friendswood, TX, 77546.

Please submit all questions in writing to Jildardo Arias, PE, CFM, ENV SP, via email to engineering@friendswood.com, no later than **March 31, 2026, at 5:00 P.M.**

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 Bid Issued	March 11, 2026
B.	NON-Mandatory Pre-Bid Meeting & Site Visit 910 S. Friendswood Dr. Friendswood, TX 77546	March 24, 2026 @ 10:00 AM
C.	Written Questions due by 5:00 PM	March 31, 2026
D.	Submittals due by 2:00 PM	April 7, 2026
E.	Submittal Evaluation	April 7, 2026 to April 14, 2026
F.	Contract Documents Submitted	April 15, 2026 to April 21, 2026
G.	Council approval	May 4, 2026

PART II: PURPOSE

- 2.1 The City of Friendswood is asking qualified firms to prepare bids for the rehabilitation of sanitary sewer Lift Station No.4.

PART III: SCOPE OF WORK

- 3.1 Bid Documents may be found on the City of Friendswood Bids website located at <https://www.ci.friendswood.tx.us/Bids.aspx> or www.civcast.com. Technical Specifications may be found on the City of Friendswood's Publication and Forms website at: <https://www.ci.friendswood.tx.us/350/Publications-Forms>.

PART IV: BIDS

The City reserves the right to reject any bid and to waive informalities in the bids. In case of ambiguity or lack of clearness in stating the prices in any bid, the City reserves the right to consider the most advantageous construction thereof, or to reject the bid. The award shall be made to the lowest responsible Bidder whose bid conforms to the specifications. Bidders will be required to furnish verifiable references with their bids. The City of Friendswood pays for goods and services according to the provisions of Chapter 2251 of the Government Code.

The successful bidder must furnish a Performance Bond and a Payment Bond in the amount of one hundred percent (100%) of the Contract Price, the forms attached hereto. A Payment Bond shall be furnished for any contract in excess of Twenty-Five Thousand Dollars (\$25,000) and a Performance Bond shall be furnished for contracts in excess of One Hundred Thousand Dollars (\$100,000). All required bonds shall be submitted to the City prior to execution of the Contract documents by the City. Payment and Performance Bonds shall be issued from sureties with a minimum "A-" rating from Best's Key Rating Guide and who are licensed by the Texas Department of Insurance to do business in the State of Texas and to issue said bonds. The bonds must be signed by an authorized representative of the surety, who is licensed by the State Board of Insurance.

In conformance with applicable statutes, the general prevailing wage rates in the locality in which the Work is to be performed have been ascertained, and such rates shall be the minimum paid for labor employed upon this project. The Contractor shall forfeit as a penalty, to the City of Friendswood, Sixty Dollars (\$60.00) for each laborer, workman or mechanic employed, for each working day, or portion thereof, in such laborer, workman or mechanic is found to be paid less than the stipulated rates for any work done under this Contract.

This Contract is issued by an organization which qualifies for exemption pursuant to the provisions of Section 151.309 of the Texas Limited Sales, Excise and Use Tax Act as codified in Chapter 151 of the Texas Tax Code. Because of Amendments to Section 151.311 of the Tax Code made by Section 14.07 of Chapter 5 (House Bill No. 11), 72nd Leg., 1st C.S., Acts 1991 at 188, in order for non-consumable materials and equipment to qualify for resale to the City and be exempt from sales tax, the contract and bids must comply with the following requirements:

- A. The bid and contract must separately identify:
 - 1. the charges for non-consumable materials and equipment that are permanently incorporated into the project and
 - 2. charges for skill, labor and consumable materials, tools and equipment that are permanently incorporated into the project. Bidders are required to have a sales tax permit issued by the Comptroller of the State of Texas in order to qualify under separated contract procedure.

00105-4

- B. The City will issue to the Contractor a specific exemption certificate for this Contract in order that he does not have to pay taxes on qualifying materials, equipment or other tangible personal property purchased for and permanently incorporated into City realty in performing this Contract. The Contractor performing this contract must issue to his suppliers an exemption certificate complying with all applicable State Comptroller's rulings, along with a copy of the certificate issued to him by the City.
- C. Total Stipulate Price contract, in which the above charges are not separated, do not qualify for sales tax and use exemption.

Attention is directed to the liquidated damages provision of this Contract (as specified in the General Conditions) and the fact that rainy weather shall constitute justification for any delay in the time for completion only under certain conditions (as specified in the General Conditions).

The City shall, after review and approval of the City Council, enter into a Contract with the lowest responsible Bidder using City Contracts and Documents per City Specifications. Bidder shall not send their own Contract Documents or in any way alter, change or amend the City's Contract Documents.

PART V: SUBMITTAL PROCESS

Please submit one (1) marked original, along with one (1) electronic copy on flash drive or CD by bid opening time of 2:00 PM on Tuesday, April 7, 2026. Flash drive or CD must contain only one (1) file in PDF format and must match the written response identically. Bids 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. Bid 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

Bids sent via courier must be sealed in a separate envelope inside of the mailer. External envelope must be marked: Bid #2026-04.

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

00105-5

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 REQUIREMENTS

Submission Requirements- the following documents must be included in your submittal:

- **Statement of Conflicts of Interest** (if any) the service provider or key employees may have regarding these services and a plan for mitigating the conflict(s). Note that the City of Friendswood may, in its sole discretion, determine whether or not a conflict disqualifies a firm and/or whether or not a conflict mitigation plan is acceptable.
- **System for Award Management** Service Providers **must have an active registration** in the System for Award Management (<https://sam.gov/>). The service provider and its Principals may not be debarred or suspended nor otherwise on the Excluded Parties List System (EPLS) in the System for Award Management (SAM). Include verification that the service provider as well as its principals are not listed (are not debarred) through the System for Award Management (<https://sam.gov/>). This clearance information should be included in the service provider's submittal. **The clearance in the Service Provider's proposal must be re-verified prior to award.** Enclose a printout of the search results that includes the record date.
- **Form Conflict of Interest Questionnaire** (enclosed). Texas Local Government Code chapter 176 requires that any vendor or person who enters or seeks to participate in a contract with a local government entity disclose in the Questionnaire Form CIQ the vendor or person's employment, affiliation, business relationship, family relationship or provision of gifts that might cause a conflict of interest with a local government entity. The questionnaire form CIQ is included in the ITB and must be submitted with the response.
- **Certification Regarding Lobbying- Disclosure of Lobbying Activities** (enclosed). Certification for Contracts, Grants, Loans, and Cooperative Agreements is included in the ITB and must be submitted with the response.
- **Form 1295** (enclosed). Effective January 1, 2018, all contracts and contract amendments, extensions, or renewals executed by the Commissioners Court will require the completion of Form 1295 "Certificate of Interested Parties" pursuant to Government Code § 2252.908. Form 1295 must be completed by the awarded vendor at the time of signed contract submission. Form 1295 is included in this

ITB for your information. Form 1295 requires the inclusion of an “unsworn declaration” which includes, among other things, the date of birth and address of the authorized representative signing the form.

- **Required Contract Provisions (enclosed).** Applicable provisions (enclosed) must be included in all contracts executed as a result of this ITB.

Contracting with small and minority businesses, women's business enterprises, and labor surplus area firms. – Small and minority businesses, women's business enterprises, and labor surplus area firms must be solicited in this ITB. If the awarded vendor is a prime contractor and may use subcontractors, the following affirmative steps are required of the prime contractor:

- 1) Placing qualified small and minority businesses and women's business enterprises on solicitation lists;
- 2) Assuring that small and minority businesses, and women's business enterprises are solicited whenever they are potential sources;
- 3) Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses, and women's business enterprises;
- 4) Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority businesses, and women's business enterprises;
- 5) Using the services and assistance, as appropriate, of such organizations as the Small Business Administration and the Minority Business Development Agency of the Department of Commerce.
- 6) Please choose the MBDA Center that is in the closest proximity to your community. Please use the following link: <https://www.mbda.gov/mbda-programs>. Email your ITB to the appropriate center. If your Center cannot be reached by email, it is strongly recommended that the ITB be sent to the appropriate center via CERTIFIED MAIL, return receipt requested.

Minority-owned businesses may be eligible for contract procurement assistance with public and private sector entities from MBDA centers:

Dallas MBDA Business Center 8828 N. Stemmons Freeway, Ste. 550B Dallas, TX 75247 214.920.2436 https://www.mbdadfw.com Email: admin1@mbdadallas.com	Houston MBDA Business Center 3100 Main Street, Ste. 701 Houston, TX 77002 713.718.8974 https://www.mbda.gov/business-center/houston-mbda-business-center Email: MBDA@hccs.edu
El Paso MBDA Business Center 2401 East Missouri Avenue El Paso, TX 79903 915.351.6232 https://www.mbda.gov/business-center/el-paso-mbda-business-center Email: treed@ephcc.org	San Antonio MBDA Business Center 501 W. Cesar E. Chavez Blvd., Ste. 3.324B San Antonio, TX 78207 210.458.2480 https://www.mbda.gov/business-center/san-antonio-mbda-business-center Email: orestes.hubbard@utsa.edu
Small and woman-owned businesses may be eligible for assistance from SBA Women's Business Centers:	
U.S. Small Business Administration – Dallas/Fort Worth District Office 150 Westpark Way, Ste. 130 Euless, TX 76040 214.572.9452/ https://www.sba.gov/offices/district/tx/dallas-fort-worth Email: dfwdo.email@sba.gov	WBEA – Women's Business Enterprise Alliance 9800 Norwest Freeway, Ste. 120 Houston, TX 77092 713.681.9232 https://www.wbea-texas.org/about-wbea Email: wbc@wbea-texas.org
LiftFund Women's Business Center 600 Soledad St. San Antonio, TX 78205 888.215.2373 https://womensbusinesscenter.sba.com/ Email: wbc@liftfund.com	
SBA also provides assistance at Small Business Development Centers located across Texas: https://americassbdc.org/small-business-consulting-and-training/find-your-sbdc/	

I. PART VII: 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.
- 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.

Anti-Collusion Affidavit

STATE OF _____

§

§

COUNTY OF _____

§

ANTI-COLLUSION AFFIDAVIT

BEFORE ME, the undersigned authority, on this day personally appeared known to me to be the person whose name is subscribed to the following, who, upon oath says:

"I am the Manager, Secretary, or other Agent or Officer or the Principal of the Proposer in the matter of the Proposal to which this affidavit is attached, and I have full knowledge of the relations of the Proposer with the other firms in this same line of business, and the Proposer is not a member of any trust, pool or combination to control the price of the services in this Proposal, or to influence any person to submit a Proposal or not to submit a Proposal thereon.

I further affirm that the Proposer has not given, offered to give, nor intends to give at any time hereafter any economic opportunity, future employment, gift, loan, gratuity, special discount, trip, favor, or service to a public servant in connection with the submitted Proposal."

AFFIANT FURTHER SAYETH NAUGHT

AFFIANT

SWORN TO AND SUBSCRIBED BEFORE ME by the above Affiant, who, on oath, states that the facts contained in the above are true and correct, this _____ day of _____, 2026.

NOTARY PUBLIC – STATE OF _____

Proposer: _____ Signed By: _____

Title: _____ Address: _____

Phone: _____

Email: _____

NOTE: PROPOSALS NOT ACCOMPANIED BY THIS AFFIDAVIT WILL NOT BE CONSIDERED

City of Friendswood, Texas is an affirmative action/equal opportunity employer. The City does not discriminate based on race, color, national origin, sex, sexual orientation, gender identity, religion, age or handicapped status in employment or the provision of services, section 3 residents, minority business enterprises, small business enterprises, women business enterprises, and labor surplus reaffirms are encouraged to submit Proposals.

Certification Regarding Lobbying Form

Applicable to Grants, Sub-grants, Cooperative Agreements, and Contracts Exceeding \$100,000.00 in Federal Funds Submission of this certification is a prerequisite for making or entering into this transaction and is imposed by section 1352, Title 31, U.S. Code. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000.00 and not more than \$100,000.00 for each such failure.

The undersigned certifies, to the best of his or her knowledge and belief, that:

- (1) No Federal appropriated funds have been paid or will be paid by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of congress, or an employee of a Member of Congress in connection with the award of a Federal contract, the making of a Federal grant, the making of a Federal loan, the entering into a cooperative agreement, and the extension continuation, renewal, amendment, or modification of a Federal contract, grant, loan or cooperative agreement.
- (2) *If any funds other than Federal appropriated funds have been paid or will be paid to any person for influence or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of congress, or an employee of a Member of Congress in connection with this Federal grant or cooperative agreement, the undersigned shall complete and submit Standard Form –LLL, “disclosure Form to Report Lobbying,” in accordance with its instructions.*
- (3) The undersigned shall require that the language of this certification be included in the award documents for all covered sub-awards exceeding \$100,000.00 in Federal funds at all appropriate tiers and that all sub-recipients shall certify and disclose accordingly.

Name of Organization

Address of Organization

Name / Title of Submitting Official

Signature Date

Statement of Conflicts of Interest

This form must be completed and submitted with the response. Please provide details regarding any conflicts of interest the service provider or key employees may have in relation to this project. If no conflicts exist, please state 'No Conflicts' below.

Potential Conflicts of Interest:

(Please describe any potential conflicts of interest or state 'No Conflicts'):

Signature of Authorized Official

Printed Name and Title of Authorized Official

Date



SB 252

CHAPTER 2252 CERTIFICATION

I, _____, the undersigned
representative of _____
(Company or business name) being an adult over the age of eighteen (18) years of
age, pursuant to Texas Government Code, Chapter 2252, Section 2252.152 and
Section 2252.153, certify that the company named above is not listed on the
website of the Comptroller of the State of Texas concerning the listing of
companies that are identified under Section 806.051, Section 807.051 or Section
2253.153. I further certify that should the above-named company enter into a
contract that is on said listing of companies on the website of the Comptroller of
the State of Texas which do business with Iran, Sudan or any Foreign Terrorist
Organization, I will immediately notify the City of Friendswood's Engineering
Department.

Name of Company Representative (Print)

Signature of Company Representative

Date

CONFLICT OF INTEREST QUESTIONNAIRE

FORM CIQ

For vendor doing business with local governmental entity

This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session.

This questionnaire is being filed in accordance with Chapter 176, Local Government Code, by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the vendor meets requirements under Section 176.006(a).

By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the vendor becomes aware of facts that require the statement to be filed. See Section 176.006(a-1), Local Government Code.

A vendor commits an offense if the vendor knowingly violates Section 176.006, Local Government Code. An offense under this section is a misdemeanor.

OFFICE USE ONLY

Date Received

1 Name of vendor who has a business relationship with local governmental entity.

2 ☐ Check this box if you are filing an update to a previously filed questionnaire. (The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date on which you became aware that the originally filed questionnaire was incomplete or inaccurate.)

3 Name of local government officer about whom the information is being disclosed.

Name of Officer

4 Describe each employment or other business relationship with the local government officer, or a family member of the officer, as described by Section 176.003(a)(2)(A). Also describe any family relationship with the local government officer. Complete subparts A and B for each employment or business relationship described. Attach additional pages to this Form CIQ as necessary.

A. Is the local government officer or a family member of the officer receiving or likely to receive taxable income, other than investment income, from the vendor?

☐ Yes ☐ No

B. Is the vendor receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer or a family member of the officer AND the taxable income is not received from the local governmental entity?

☐ Yes ☐ No

5 Describe each employment or business relationship that the vendor named in Section 1 maintains with a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership interest of one percent or more.

6 ☐ Check this box if the vendor has given the local government officer or a family member of the officer one or more gifts as described in Section 176.003(a)(2)(B), excluding gifts described in Section 176.003(a-1).

7 _____
Signature of vendor doing business with the governmental entity

Date

CONFLICT OF INTEREST QUESTIONNAIRE

For vendor doing business with local governmental entity

A complete copy of Chapter 176 of the Local Government Code may be found at <http://www.statutes.legis.state.tx.us/Docs/LG/htm/LG.176.htm>. For easy reference, below are some of the sections cited on this form.

Local Government Code § 176.001(1-a): "Business relationship" means a connection between two or more parties based on commercial activity of one of the parties. The term does not include a connection based on:

- (A) a transaction that is subject to rate or fee regulation by a federal, state, or local governmental entity or an agency of a federal, state, or local governmental entity;
- (B) a transaction conducted at a price and subject to terms available to the public; or
- (C) a purchase or lease of goods or services from a person that is chartered by a state or federal agency and that is subject to regular examination by, and reporting to, that agency.

Local Government Code § 176.003(a)(2)(A) and (B):

(a) A local government officer shall file a conflicts disclosure statement with respect to a vendor if:

(2) the vendor:

(A) has an employment or other business relationship with the local government officer or a family member of the officer that results in the officer or family member receiving taxable income, other than investment income, that exceeds \$2,500 during the 12-month period preceding the date that the officer becomes aware that

(i) a contract between the local governmental entity and vendor has been executed;
or

(ii) the local governmental entity is considering entering into a contract with the vendor;

(B) has given to the local government officer or a family member of the officer one or more gifts that have an aggregate value of more than \$100 in the 12-month period preceding the date the officer becomes aware that:

- (i) a contract between the local governmental entity and vendor has been executed; or
- (ii) the local governmental entity is considering entering into a contract with the vendor.

Local Government Code § 176.006(a) and (a-1)

(a) A vendor shall file a completed conflict of interest questionnaire if the vendor has a business relationship with a local governmental entity and:

(1) has an employment or other business relationship with a local government officer of that local governmental entity, or a family member of the officer, described by Section 176.003(a)(2)(A);

(2) has given a local government officer of that local governmental entity, or a family member of the officer, one or more gifts with the aggregate value specified by Section 176.003(a)(2)(B), excluding any gift described by Section 176.003(a-1); or

(3) has a family relationship with a local government officer of that local governmental entity.

(a-1) The completed conflict of interest questionnaire must be filed with the appropriate records administrator not later than the seventh business day after the later of:

(1) the date that the vendor:

(A) begins discussions or negotiations to enter into a contract with the local governmental entity; or

(B) submits to the local governmental entity an application, response to a request for proposals or bids, correspondence, or another writing related to a potential contract with the local governmental entity; or

(2) the date the vendor becomes aware:

(A) of an employment or other business relationship with a local government officer, or a family member of the officer, described by Subsection (a);

(B) that the vendor has given one or more gifts described by Subsection (a); or

(C) of a family relationship with a local government officer.

DISCLOSURE OF LOBBYING ACTIVITIES

Complete this form to disclose lobbying activities pursuant to 31 U.S.C. 1352

Approved by OMB

0348-0046

(See reverse for public burden disclosure.)

1. Type of Federal Action: ☐ a. contract ☐ b. grant ☐ c. cooperative agreement ☐ d. loan ☐ e. loan guarantee ☐ f. loan insurance		2. Status of Federal Action: ☐ a. bid/offer/application ☐ b. initial award ☐ c. post-award		3. Report Type: ☐ a. initial filing ☐ b. material change For Material Change Only: year quarter date of last report	
4. Name and Address of Reporting Entity: ☐ Prime ☐ Subawardee Tier , if known : 			5. If Reporting Entity in No. 4 is a Subawardee, Enter Name and Address of Prime: 		
6. Federal Department/Agency: 			7. Federal Program Name/Description: 		
			CFDA Number, if applicable :		
8. Federal Action Number, if known : 			9. Award Amount, if known : \$		
10. a. Name and Address of Lobbying Registrant (if individual, last name, first name, MI): 			b. Individuals Performing Services (including address if different from No. 10a) (last name, first name, MI): 		
11. Information requested through this form is authorized by title 31 U.S.C. section 1352. This disclosure of lobbying activities is a material representation of fact upon which reliance was placed by the tier above when this transaction was made or entered into. This disclosure is required pursuant to 31 U.S.C. 1352. This information will be reported to the Congress semi-annually and will be available for public inspection. Any person who fails to file the required disclosure shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.			Signature: Print Name: Title: Telephone No.: Date:		

Federal Use Only:

Authorized for Local Reproduction
Standard Form LLL (Rev. 7-97)

INSTRUCTIONS FOR COMPLETION OF SF-LLL, DISCLOSURE OF LOBBYING ACTIVITIES

This disclosure form shall be completed by the reporting entity, whether subawardee or prime Federal recipient, at the initiation or receipt of a covered Federal action, or a material change to a previous filing, pursuant to title 31 U.S.C. section 1352. The filing of a form is required for each payment or agreement to make payment to any lobbying entity for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with a covered Federal action. Complete all items that apply for both the initial filing and material change report. Refer to the implementing guidance published by the Office of Management and Budget for additional information.

1. Identify the type of covered Federal action for which lobbying activity is and/or has been secured to influence the outcome of a covered Federal action.
2. Identify the status of the covered Federal action.
3. Identify the appropriate classification of this report. If this is a followup report caused by a material change to the information previously reported, enter the year and quarter in which the change occurred. Enter the date of the last previously submitted report by this reporting entity for this covered Federal action.
4. Enter the full name, address, city, State and zip code of the reporting entity. Include Congressional District, if known. Check the appropriate classification of the reporting entity that designates if it is, or expects to be, a prime or subaward recipient. Identify the tier of the subawardee, e.g., the first subawardee of the prime is the 1st tier. Subawards include but are not limited to subcontracts, subgrants and contract awards under grants.
5. If the organization filing the report in item 4 checks "Subawardee," then enter the full name, address, city, State and zip code of the prime Federal recipient. Include Congressional District, if known.
6. Enter the name of the Federal agency making the award or loan commitment. Include at least one organizational level below agency name, if known. For example, Department of Transportation, United States Coast Guard.
7. Enter the Federal program name or description for the covered Federal action (item 1). If known, enter the full Catalog of Federal Domestic Assistance (CFDA) number for grants, cooperative agreements, loans, and loan commitments.
8. Enter the most appropriate Federal identifying number available for the Federal action identified in item 1 (e.g., Request for Proposal (RFP) number; Invitation for Bid (IFB) number; grant announcement number; the contract, grant, or loan award number; the application/proposal control number assigned by the Federal agency). Include prefixes, e.g., "RFP-DE-90-001."
9. For a covered Federal action where there has been an award or loan commitment by the Federal agency, enter the Federal amount of the award/loan commitment for the prime entity identified in item 4 or 5.
10. (a) Enter the full name, address, city, State and zip code of the lobbying registrant under the Lobbying Disclosure Act of 1995 engaged by the reporting entity identified in item 4 to influence the covered Federal action.

(b) Enter the full names of the individual(s) performing services, and include full address if different from 10 (a). Enter Last Name, First Name, and Middle Initial (MI).
11. The certifying official shall sign and date the form, print his/her name, title, and telephone number.

According to the Paperwork Reduction Act, as amended, no persons are required to respond to a collection of information unless it displays a valid OMB Control Number. The valid OMB control number for this information collection is OMB No. 0348-0046. Public reporting burden for this collection of information is estimated to average 10 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Office of Management and Budget, Paperwork Reduction Project (0348-0046), Washington, DC 20503.



Non-Disclosure Agreement

In consideration of the City of Friendswood retaining the services of a consultant and because of the sensitivity of certain information which may come under the care and control of Consultant, both parties agree that all information regarding the City or any selected City agency subject to this Contract; or gathered, produced, or derived from this project (Confidential Information) must remain confidential subject to release only by permission of the City, and more specifically agree as follows:

Media releases pertaining to this ITB and/or any resulting contract, or the services to which they relate, will not be made without the prior written consent of the City, and then only in accordance with explicit written instructions from the City. The disclosure of the contents of proposals prior to the award of a contract under this ITB, or any other violation of this section, may result in disqualification.

1. The Information may be used by Consultant only to assist Consultant in connection with its engagement with the City.
2. Consultant will not, at any time, use the Information in any fashion, form, or manner except in its capacity as independent consultant to the City.
3. Consultant agrees to maintain the confidentiality of all deliverables resulting from this Contract in the same manner that it protects the confidentiality of its own proprietary products of like kind.
4. The Information may not be copied or reproduced without the City's written consent.
5. All materials made available to Consultant, including copies thereof, must be returned to the City upon the first to occur of; (a) completion of the project, or (b) request by the City.
6. The foregoing must not prohibit or limit Consultant use of the information (including, but not limited to, ideas, concepts, know-how, techniques and methodologies) (a) previously known to it, (b) independently developed by it, (c) acquired by it from a third party, or (d) which is or becomes part of the public domain through no breach to Consultant of this agreement.
7. This agreement shall become effective as of the date Information is first made available to Consultant and must survive the contract and be a continuing requirement.
8. The breach of this Nondisclosure Agreement by Consultant shall entitle the City to immediately terminate the Agreement upon written notice to Proposer for such breach. The parties acknowledge that the measure of damages in the event of a breach of this Nondisclosure Agreement may be difficult or impossible to calculate, depending on the nature of the breach. Regardless of whether the City elects to terminate the Agreement upon the breach hereof, the City may require Consultant to pay to the City the sum of \$1,000 for each breach as liquidated damages. This amount is not intended to be in the nature of a penalty but is intended to be a reasonable estimate of the amount of damages to the City in the event of a breach hereof by Consultant. Comptroller does not waive any right to seek additional relief, either equitable or otherwise, concerning any breach of this Agreement.

Printed Name of Consultant _____

By: _____

Title: _____

Date: _____

System For Award Management Information

**Federal Award Management Registration**

CALL NOW TO SPEAK TO A REGISTRATION SPECIALIST
 **(844) 513-9067**



SYSTEM FOR AWARD MANAGEMENT REGISTRATION SUPPORT

Complete Your SAM.gov Registration Or Renewal Online. Registration Advisors Are Standing By To Provide Immediate Assistance And Expedited Registration Service.

START YOUR SAM REGISTRATION HERE!

What type of registration is this?
☐ New ☐ SAM Renewal ☐ CCR Renewal

Get Registered Now!

Step 1 of 3 contact details

System For Award Management Registration

SAM Registration Is Required To Win Contracts and Receive Grants

A SAM registration is required for any business, organization, or agency that is eligible to, or plans to, receive payments from the federal government. In order to qualify for federal contracts or grants, a fully accurate, and compliant System For Award Management registration is required. More importantly if you have already completed a government contract or have been awarded a grant, an up-to-date SAM registration is required in order for you to receive payment.



Registration Specialists Are Standing By To Assist

SAM | CCR | ORCA | CAGE

Get Your SAM Registration Expedited

(844) 513-9067

Proposer Shall Return Completed Form with Proposal

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.

REQUIRED CONTRACT PROVISIONS

2 CFR 200.327 Contract provisions. The non-Federal entity's contracts should contain applicable provisions described in Appendix II to Part 200—Contract Provisions for non-Federal Entity Contracts Under Federal Awards. The non-Federal entity's contracts must contain the provisions described in Appendix II to Part 200—Contract Provisions for non-Federal Entity Contracts Under Federal Awards, as applicable. ***Language as of May 8, 2024.**

THRESHOLD	PROVISION	CITATION
>\$250,000 (Simplified Acquisition Threshold)	Contracts for more than the simplified acquisition threshold, which is the inflation adjusted amount determined by the Civilian Agency Acquisition Council and the Defense Acquisition Regulations Council (Councils) as authorized by 41 U.S.C. 1908 , must address administrative, contractual, or legal remedies in instances where contractors violate or breach contract terms, and provide for such sanctions and penalties as appropriate.	2 CFR 200 APPENDIX II (A)
>\$10,000	All contracts in excess of \$10,000 must address termination for cause and for convenience by the non-Federal entity including the manner by which it will be effected and the basis for settlement.	2 CFR 200 APPENDIX II (B)
None	Equal Employment Opportunity. Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of "federally assisted construction contract" in 41 CFR Part 60-1.3 must include the equal opportunity clause provided under 41 CFR 60-1.4(b), in accordance with Executive Order 11246, "Equal Employment Opportunity" (30 FR 12319, 12935, 3 CFR Part, 1964-1965 Comp., p. 339), as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and implementing regulations at 41 CFR part 60, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor." 41 CFR 60-1.4 Equal opportunity clause. (b) Federally assisted construction contracts. (1) Except as otherwise provided, each administering agency shall require the inclusion of the following language as a condition of any grant, contract, loan, insurance, or guarantee involving federally assisted construction which is not exempt from the requirements of the equal opportunity clause: The [recipient] hereby agrees that it will incorporate or cause to be incorporated into any contract for construction work, or modification thereof, as defined in the regulations of the Secretary of Labor at 41 CFR Chapter 60, which is paid for in whole or in part with funds obtained from the Federal Government or borrowed on the credit of the Federal Government pursuant to a grant, contract, loan, insurance, or guarantee, or undertaken pursuant to any Federal program involving such grant, contract, loan, insurance, or guarantee, the following equal opportunity clause: During the performance of this contract, the contractor agrees as follows: (1) The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or	2 CFR 200 APPENDIX II C and 41 CFR §60-1.4(b)

	national origin. Such action shall include, but not be 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. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause. (2) The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin. (3) The contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the contractor's legal duty to furnish information. (4) The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment. (5) The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor. (6) The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.	

	(7) In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law. (8) The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the contractor may request the United States to enter into such litigation to protect the interests of the United States. The [recipient] further agrees that it will be bound by the above equal opportunity clause with respect to its own employment practices when it participates in federally assisted construction work: Provided, that if the [recipient] so participating is a State or local government, the above equal opportunity clause is not applicable to any agency, instrumentality or subdivision of such government which does not participate in work on or under the contract. The [recipient] agrees that it will assist and cooperate actively with the administering agency and the Secretary of Labor in obtaining the compliance of contractors and subcontractors with the equal opportunity clause and the rules, regulations, and relevant orders of the Secretary of Labor, that it will furnish the administering agency and the Secretary of Labor such information as they may require for the supervision of such compliance, and that it will otherwise assist the administering agency in the discharge of the agency's primary responsibility for securing compliance. The [recipient] further agrees that it will refrain from entering into any contract or contract modification subject to Executive Order 11246 of September 24, 1965, with a contractor debarred from, or who has not demonstrated eligibility for, Government contracts and federally assisted construction contracts pursuant to the Executive Order and will carry out such sanctions and penalties for violation of the equal opportunity clause as may be imposed upon contractors and subcontractors by the administering agency or the Secretary of Labor pursuant to Part II, Subpart D of the Executive Order. In addition, the [recipient] agrees that if it fails or refuses to comply with these undertakings,	

	the administering agency may take any or all of the following actions: Cancel, terminate, or suspend in whole or in part this grant (contract, loan, insurance, guarantee); refrain from extending any further assistance to the [recipient] under the program with respect to which the failure or refund occurred until satisfactory assurance of future compliance has been received from such [recipient]; and refer the case to the Department of Justice for appropriate legal proceedings.	
>\$2,000	Davis-Bacon Act, as amended (40 U.S.C. 3141-3148). When required by Federal program legislation, all prime construction contracts in excess of \$2,000 awarded by non-Federal entities must include a provision for compliance with the Davis-Bacon Act (40 U.S.C. 3141-3144 , and 3146-3148) as supplemented by Department of Labor regulations (29 CFR Part 5 , "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction"). In accordance with the statute, contractors must be required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week. The non-Federal entity must place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation. The decision to award a contract or subcontract must be conditioned upon the acceptance of the wage determination. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency. The contracts must also include a provision for compliance with the Copeland "Anti-Kickback" Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part 3 , "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States"). The Act provides that each contractor or subrecipient must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency.	2 CFR 200 APPENDIX II (D)
>\$100,000	Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708). Where applicable, all contracts awarded by the non-Federal entity in excess of \$100,000 that involve the employment of mechanics or laborers must include a provision for compliance with 40 U.S.C. 3702 and 3704 , as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, each contractor must be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.	2 CFR 200 APPENDIX II (E)
None	Rights to Inventions Made Under a Contract or Agreement. If the Federal award meets the definition of "funding agreement" under 37 CFR § 401.2 (a) and the recipient or subrecipient wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that	2 CFR 200 APPENDIX II (F)

	“funding agreement,” the recipient or subrecipient must comply with the requirements of 37 CFR Part 401 , “Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements,” and any implementing regulations issued by the awarding agency.	
>\$150,000	Clean Air Act (42 U.S.C. 7401-7671q .) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387), as amended - Contracts and subgrants of amounts in excess of \$150,000 must contain a provision that requires the non-Federal award to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).	2 CFR 200 APPENDIX II (G)
>\$25,000	Debarment and Suspension (Executive Orders 12549 and 12689) - A contract award (see 2 CFR 180.220) must not be made to parties listed on the governmentwide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), “Debarment and Suspension.” SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.	2 CFR 200 APPENDIX II (H)
>\$100,000	Byrd Anti-Lobbying Amendment (31 U.S.C. 1352) - Contractors that apply or bid for an award exceeding \$100,000 must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352 . Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the non-Federal award.	2 CFR 200 APPENDIX II (I) and 24 CFR §570.303
	See 2 CFR §200.323.	2 CFR 200 APPENDIX II (J)
	See 2 CFR §200.216.	2 CFR 200 APPENDIX II (K)
	See 2 CFR §200.322.	2 CFR 200 APPENDIX II (L)
>\$10,000	A non-Federal entity that is a state agency or agency of a political subdivision of a state and its contractors must comply with section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements of Section 6002 include procuring only items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition, where the purchase price of the item exceeds \$10,000 or the value of the quantity acquired during the preceding fiscal year exceeded \$10,000; procuring solid waste management services in a manner that maximizes energy and resource recovery; and establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines.	2 CFR 200.323
>\$100,000	<i>§135.38 Section 3 clause</i>	

	<i>All section 3 covered contracts shall include the following clause (referred to as the section 3 clause):</i> A. The work to be performed under this contract is subject to the requirements of section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. 1701u (Section 3). The purpose of section 3 is to ensure that employment and other economic opportunities generated by HUD assistance or HUD-assisted projects covered by section 3, shall, to the greatest extent feasible, be directed to low- and very low-income persons, particularly persons who are recipients of HUD assistance for housing. B. The parties to this contract agree to comply with HUD's regulations in 24 CFR part 135, which implement section 3. As evidenced by their execution of this contract, the parties to this contract certify that they are under no contractual or other impediment that would prevent them from complying with the part 135 regulations. C. The contractor agrees to send to each labor organization or representative of workers with which the contractor has a collective bargaining agreement or other understanding, if any, a notice advising the labor organization or workers' representative of the contractor's commitments under this section 3 clause, and will post copies of the notice in conspicuous places at the work site where both employees and applicants for training and employment positions can see the notice. The notice shall describe the section 3 preference, shall set forth minimum number and job titles subject to hire, availability of apprenticeship and training positions, the qualifications for each; and the name and location of the person(s) taking applications for each of the positions; and the anticipated date the work shall begin. D. The contractor agrees to include this section 3 clause in every subcontract subject to compliance with regulations in 24 CFR part 135, and agrees to take appropriate action, as provided in an applicable provision of the subcontract or in this section 3 clause, upon a finding that the subcontractor is in violation of the regulations in 24 CFR part 135. The contractor will not subcontract with any subcontractor where the contractor has notice or knowledge that the subcontractor has been found in violation of the regulations in 24 CFR part 135. E. The contractor will certify that any vacant employment positions, including training positions, that are filled (1) after the contractor is selected but before the contract is executed, and (2) with persons other than those to whom the regulations of 24 CFR part 135 require employment opportunities to be directed, were not filled to circumvent the contractor's obligations under 24 CFR part 135. F. Noncompliance with HUD's regulations in 24 CFR part 135 may result in sanctions, termination of this contract for default, and debarment or suspension from future HUD assisted contracts. G. With respect to work performed in connection with section 3 covered Indian housing assistance, section 7(b) of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450e) also applies to the work to be performed under this contract. Section 7(b) requires that to the greatest extent feasible (i)	

	preference and opportunities for training and employment shall be given to Indians, and (ii) preference in the award of contracts and subcontracts shall be given to Indian organizations and Indian-owned Economic Enterprises. Parties to this contract that are subject to the provisions of section 3 and section 7(b) agree to comply with section 3 to the maximum extent feasible, but not in derogation of compliance with section 7(b).	
None	Section 889(b)(1) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (FY2019 NDAA) and 2 C.F.R. § 200.216, as implemented by FEMA Policy 405-143-1, Prohibitions on Expending FEMA Award Funds for Covered Telecommunications Equipment or Services (Interim), prohibit the obligation or expending of federal award funds on certain telecommunication products or from certain entities for national security reasons. Effective August 13, 2020, FEMA recipients and subrecipients, as well as their contractors and subcontractors, may not obligate or expend any FEMA award funds to: Recipients and subrecipients are prohibited from obligating or expending loan or grant funds to: (1) Procure or obtain; (2) Extend or renew a contract to procure or obtain; or (3) Enter into a contract (or extend or renew a contract) to procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As described in Public Law 115-232, section 889, covered telecommunications equipment is telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities). (i) For the purpose of public safety, security of government facilities, physical security surveillance of critical infrastructure, and other national security purposes, video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities). (ii) Telecommunications or video surveillance services provided by such entities or using such equipment. (iii) Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country. (b) In implementing the prohibition under Public Law 115-232, section 889, subsection (f), paragraph (1), heads of executive agencies administering loan, grant, or subsidy programs shall prioritize available funding and technical support to assist affected businesses, institutions and organizations as is reasonably necessary for those affected entities to transition from covered communications equipment and services, to procure replacement equipment	2 CFR 200.216

	and services, and to ensure that communications service to users and customers is sustained. (c) See Public Law 115-232, section 889 for additional information. (d) See also § 200.471.	
None	§ 200.322 Domestic preferences for procurements. (a) As appropriate and to the extent consistent with law and to the greatest extent practicable under a Federal award, provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States (including but not limited to iron, aluminum, steel, cement, and other manufactured products). The requirements of this section must be included in all subawards including all contracts and purchase orders for work or products under this award. (b) For purposes of this section: (1) “Produced in the United States” means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States. (2) “Manufactured products” means items and construction materials composed in whole or in part of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber. (3) [Iron and steel products, Manufactured Products, and Construction Materials] used in this project comply with the Build America, Buy America Act (BABA) requirements mandated by Title IX of the Infrastructure Investment and Jobs Act (“IIJA”), Pub. L. 117-58.	2 CFR 200.322
None	The Federal awarding agency must establish conflict of interest policies for Federal awards. The non-Federal entity must disclose in writing any potential conflict of interest to the Federal awarding agency or pass-through entity in accordance with applicable Federal awarding agency policy.	2 CFR 200.112
None	The Federal awarding agency and the non-Federal entity should, whenever practicable, collect, transmit, and store Federal award-related information in open and machine-readable formats rather than in closed formats or on paper in accordance with applicable legislative requirements. A machine-readable format is a format in a standard computer language (not English text) that can be read automatically by a web browser or computer system. The Federal awarding agency or pass-through entity must always provide or accept paper versions of Federal award-related information to and from the non-Federal entity upon request. If paper copies are submitted, the Federal awarding agency or pass-through entity must not require more than an original and two copies. When original records are electronic and cannot be altered, there is no need to create and retain paper copies. When original records are paper, electronic versions may be substituted through the use of duplication or other forms of electronic media provided that they are subject to periodic quality control reviews, provide reasonable safeguards against alteration, and remain readable.	2 CFR 200.336
None	Contracting with HUB, small and minority businesses, women's business enterprises, and labor surplus area firms. (a) The non-Federal entity must take all necessary affirmative steps to assure that minority businesses, women's business enterprises, and labor surplus area firms are used when possible. (b) Affirmative steps must include:	2 CFR 200.321

	(1) Placing qualified small and minority businesses and women's business enterprises on solicitation lists; (2) Assuring that small and minority businesses, and women's business enterprises are solicited whenever they are potential sources; (3) Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses, and women's business enterprises; (4) Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority businesses, and women's business enterprises; (5) Using the services and assistance, as appropriate, of such organizations as the Small Business Administration and the Minority Business Development Agency of the Department of Commerce; and (6) Requiring the prime contractor, if subcontracts are to be let, to take the affirmative steps listed in paragraphs (b)(1) through (5) of this section.	
None	Financial records, supporting documents, statistical records, and all other non-Federal entity records pertinent to a Federal award must be retained for a period of three years from the date of submission of the final expenditure report or, for Federal awards that are renewed quarterly or annually, from the date of the submission of the quarterly or annual financial report, respectively, as reported to the Federal awarding agency or pass-through entity in the case of a subrecipient. Federal awarding agencies and pass-through entities must not impose any other record retention requirements upon non-Federal entities. The only exceptions are the following: (a) If any litigation, claim, or audit is started before the expiration of the 3-year period, the records must be retained until all litigation, claims, or audit findings involving the records have been resolved and final action taken. (b) When the non-Federal entity is notified in writing by the Federal awarding agency, cognizant agency for audit, oversight agency for audit, cognizant agency for indirect costs, or pass-through entity to extend the retention period. (c) Records for real property and equipment acquired with Federal funds must be retained for 3 years after final disposition. (d) When records are transferred to or maintained by the Federal awarding agency or pass-through entity, the 3-year retention requirement is not applicable to the non-Federal entity. (e) Records for program income transactions after the period of performance. In some cases, recipients must report program income after the period of performance. Where there is such a requirement, the retention period for the records pertaining to the earning of the program income starts from the end of the non-Federal entity's fiscal year in which the program income is earned. (f) Indirect cost rate proposals and cost allocations plans. This paragraph applies to the following types of documents and their supporting records: Indirect cost rate computations or proposals, cost allocation plans, and any similar accounting computations of the rate at which a particular group of costs is chargeable (such as computer usage chargeback rates or composite fringe benefit rates). (1) <i>If submitted for negotiation.</i> If the proposal, plan, or other computation is required to be submitted to the Federal Government (or to the pass-through entity) to form the basis for negotiation of the rate, then the 3-year retention period for its supporting records starts from the date of such submission. (2) <i>If not submitted for negotiation.</i> If the proposal, plan, or other computation is not required to be submitted to the Federal Government (or to the pass-	2 CFR 200.334

	through entity) for negotiation purposes, then the 3-year retention period for the proposal, plan, or computation and its supporting records starts from the end of the fiscal year (or other accounting period) covered by the proposal, plan, or other computation.	
None	CONTRACTS WITH COMPANIES ENGAGED IN BUSINESS WITH IRAN, SUDAN, OR FOREIGN TERRORIST ORGANIZATION PROHIBITED. A governmental entity may not enter into a governmental contract with a company that is identified on a list prepared and maintained under Section 2270.0052, 2270.0102, or 2270.0152. In accordance with Texas Government Code, Chapter 2252, Subchapter F, Respondent hereby represents and warrants that it is not a company identified on the lists prepared and maintained under Texas Government Code §§ 2270.0052 (companies with business operations in Sudan), 2270.0102 (companies with business operations in Iran), or 2270.0152 (companies known to have contracts with or provide supplies or services to a foreign terrorist organization). Notwithstanding the foregoing, a company that the United States government affirmatively declares to be excluded from its federal sanctions regime relating to Sudan, Iran, or to a foreign terrorist organization, is not subject to contract prohibition under this clause. A company claiming such exemption must submit the official copy of the declaration.	Texas Government Code 2252.152
>\$100,000	PROVISION REQUIRED IN CONTRACT. (a) This section applies only to certain solicitations and contracts. Section 2271.002 of the Texas Government Code states the following: (a) This section applies only to a contract that: (1) is between a governmental entity and a company with 10 or more full-time employees; and (2) has a value of \$100,000 or more that is to be paid wholly or partly from public funds of the governmental entity. (b) A governmental entity may not enter into a contract with a company for goods or services unless the contract contains a written verification from the company that it: (1) does not boycott Israel; and (2) will not boycott Israel during the term of the contract. Section 2271.001(2) of the Government Code defines "company" to be the meaning assigned by Section 808.001 of the Texas Government Code, except that the term does not include a sole proprietorship.	Texas Government Code 2271.002
Option Contract Language for contracts awarded prior to Grant Award	The contract award is contingent upon the receipt of federal funds. If no such funds are awarded, the contract shall terminate.	Optional
	Mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act.	42 U.S.C. 6201
	The Firm agrees that no otherwise qualified individual with disabilities shall, solely by reason of his/her disability, be denied the benefits of, or be subjected to discrimination, including discrimination in employment, under any program or activity receiving federal financial assistance.	Section 504 of the Rehabilitation Act of 1973, as amended.
	Pursuant to the <i>Violence Against Women Act Reauthorization of 2022</i> , the Grant Recipient must certify that local policies do not interfere with the residents' Right to Report Crime and Emergencies from One's Home. The certification will confirm that no ordinances, local regulations, or policies adopted by the local	Pub. L. 117-103, 136 Stat. 49

	government and currently in effect contain any financial or regulatory penalty imposed on property owners or residents as a result of any use of emergency services, or that the Grant Recipient is actively addressing such local regulations.	

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 §
 §
COUNTY OF GALVESTON §

Bond Number:[INSERT BOND #]

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: 2020 Lift Station Mitigations Package 4 - Lift Station 4
Construction Services
BID NUMBER: BID# 2026-04
PROJECT NUMBER: LS004 MIT
PROJECT LOCATION: 2510 Airline Drive, Friendswood, TX

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**

UNIT PRICE BID FORM

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

Project: 2020 Lift Station Mitigation Package 4 - Lift Station 4 Construction
Services

Project No.: LS004 MIT

Bid No.: 2026-04

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

PART I: OFFER

- 1.1 Total Bid 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 Bid 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 Bid Price.
- 1.3 Period for Bid Acceptance: This offer is open to acceptance and is irrevocable for ninety (90) days from the Bid Date. That period may be extended by mutual written agreement of the City and the Bidder.
- 1.4 Addenda: All Addenda have been received. Modifications to the 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, the Contractor shall achieve the Date of Substantial Completion within THREE HUNDRED AND SIXTY-FIVE (365) 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, except for the standby generator work which shall be substantially completed within SIX HUNDRED (600) calendar days after the date of

commencement of the Work.

- 2.2 It is also understood and agreed that the Work shall be completed in full within THREE HUNDRED AND NINETY-FIVE (395) 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, except for the standby generator work which shall be completed in full within SIX HUNDRED AND THIRTY (630) calendar days after the date of commencement of the Work.

PART III: CONTRACT PRICE

- 3.1 Total Bid Price has been Calculated by the Bidder, using the following component prices and process (Print or Type numerical amounts).
- 3.2 The Total Base Bid Price for the Bid shall be the determining factor for Contract of the successful low Bidder.

PART IV: ACKNOWLEDGEMENT

- 4.1 The undersigned, as the Bidder, 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 Invitation to Bidders, Instructions to Bidders, this Bid 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 bids. It is further understood that all items of work for which there are no specific pay items are included in the bid items shown on this Bid 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 bidder whose bid 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 bid 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 Bidder. Further, should the City bring suit in court to enforce any terms of this bid, it is agreed that the Bidder 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 bid prices contained in this bid 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 bid prices on any item be omitted, the right to apply the lowest prices submitted by any other bidders for the omitted items in payment for work done under this proposal.
- 4.9 Bidder understands that the City reserves the right to reject any and all bids and to waive any informalities in the bidding. In addition, the City reserves the right to award the Contract on the basis of the Total Base Bid.
- 4.10 Bids shall be good for ninety (90) days from the date of the bid opening.

PART V: UNIT PRICE BID FORMS

- 5.1 The following forms shall constitute the Bid Forms.

UNIT PRICE BID FORM

Item No.	Description of Item w/Unit Bid Price Written in Words	Qty.	Unit	Unit Bid Price	Extended Amount
1	Mobilization, Permits and General Requirements: Furnish all labor, materials, equipment, and incidentals required for the Contractor to mobilize and demobilize, including all costs for Contractor's insurances and bonds, construction permits and fees, general requirements specified in Division 1 of the Project Manual, and site administration expenses and utilities.	1	LS		
@ _____					
2	Demolish Wet Well Access Hatch: Furnish all labor, materials, equipment, and incidentals required for the Contractor to demolish existing wet well access hatch and cover plate, including all costs for hauling and disposing of materials off-site.	1	LS		
@ _____					
3	Demolish Standby Generator Platform: Furnish all labor, materials, equipment, and incidentals required for the Contractor to demolish existing standby power generator platform including foundation and all costs for hauling and disposing of materials off-site.	1	LS		
@ _____					

UNIT PRICE BID FORM

Item No.	Description of Item w/Unit Bid Price Written in Words	Qty.	Unit	Unit Bid Price	Extended Amount
4	Demolish Old Electrical Equipment: Furnish all labor, materials, equipment, and incidentals required for the Contractor to demolish existing standby generator, electrical panels, control panels, instrumentation, conduits, and miscellaneous items as shown on the drawings including all costs for hauling and disposing of materials off-site and providing temporary power as needed during construction.	1	LS		
@ _____					
5	Demolish Wood Fence and Gate: Furnish all labor, materials, equipment, and incidentals required for the Contractor to demolish existing wood fence and gate, including all costs for hauling and disposing of materials off-site.	1	LS		
@ _____					
6	Demolish Asphalt Driveway: Furnish all labor, materials, equipment, and incidentals required for the Contractor to demolish existing asphalt driveway, including culvert, excavation, and all costs for hauling and disposing of materials off-site.	1	LS		
@ _____					

UNIT PRICE BID FORM

Item No.	Description of Item w/Unit Bid Price Written in Words	Qty.	Unit	Unit Bid Price	Extended Amount
7	Remove Airport Beacon Pole and Demolish Foundation: Furnish all labor, materials, equipment, and incidentals required for the Contractor to remove the existing airport beacon pole, and demolish the pole foundation, including delivery of pole and beacon to airport property, and all costs for hauling and disposing of materials off-site.	1	LS		
@ _____					
8	Remove Existing trees: Furnish all labor, materials, equipment, and incidentals required for the Contractor to remove the existing trees, including tree roots, and all costs for shredding, hauling and disposing of materials off-site.	3	EA		
@ _____					
9	Hose Bib Relocation and Backflow Preventer: Furnish all labor, materials, equipment, and incidentals required for the Contractor to demolish existing hose bib station and new hose bib station including hose bib, piping, fittings, couplings, adapters, supports, connections, excavation, bedding and backfill as shown on the plans, complete in-place.	1	LS		
@ _____					

UNIT PRICE BID FORM

Item No.	Description of Item w/Unit Bid Price Written in Words	Qty.	Unit	Unit Bid Price	Extended Amount
10	Wooden Fence: Furnish all labor, materials, equipment, and incidentals required for the Contractor to construct an 8-ft tall wooden fence as shown on the plans.	124	LF		
@ _____					
11	Wooden Gate: Furnish all labor, materials, equipment, and incidentals required for the Contractor to construct a 16-ft wide wooden swing gate as shown on the plans.	1	EA		
@ _____					
12	Concrete Driveway: Furnish all labor, materials, equipment, and incidentals required for the Contractor to construct a concrete driveway including excavation, subgrade preparation, base material, bedding, backfill, fill material, ditch regrading and culvert as shown on the plans.	2	EA		
@ _____					
13	Gravel Parking: Furnish all labor, materials, equipment, and incidentals required for the Contractor to construct a 8-inch thick gravel parking area including excavation, subgrade preparation, base material, geotextile, bedding, backfill and fill material as shown on the plans.	1	LS		
@ _____					

00145-7

UNIT PRICE BID FORM

Item No.	Description of Item w/Unit Bid Price Written in Words	Qty.	Unit	Unit Bid Price	Extended Amount
14	Watertight Wet Well Access Hatch: Furnish all labor, materials, equipment, and incidentals required for the Contractor to furnish and install a watertight access hatch as shown on the plans, including all costs of coordinating with manufacturer for a complete in-place installation.	1	LS		
@ _____					
15	Electrical Equipment and Generator Platform: Furnish all labor, materials, equipment, and incidentals required for the Contractor to construct an electrical equipment and standby power generator elevated platform as shown on the plans, including stairs, concrete stair landing, foundation, for a complete in-place installation.	1	LS		
@ _____					
16	Control Panel Canopy: Furnish all labor, materials, equipment, and incidentals required for the Contractor to construct a control panel canopy as shown on the plans, including all members, hardware, and incidentals for a complete in-place installation.	1	LS		
@ _____					

UNIT PRICE BID 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>
17	Electrical & Instrumentation Improvements: Furnish and install all lift station Instrumentation and Electrical Improvements as shown on the Drawings, for a complete working system including but not limited to instrumentation and control assemblies, Service equipment, generator, conduit, conductors, SCADA capabilities, all related appurtenances, including required studies, testing, and coordination.	1	LS		
@ _____					

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	BIDDERS INITIALED
1			
2			
3			
4			
5			

5.4 ALLOWANCES

1. Allowance Type: Texas New Mexico Power (TNMP) Cash Allowance.
\$40,000.00

5.5 BID PRICES

- A. TOTAL BASE BID** _____
- B. TOTAL ALTERNATES** _____
- C. TOTAL ALLOWANCES** _____ **\$40,000.00** _____
- D. TOTAL STIPULATED PRICE** _____

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 Bid Price.

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 VII: AFFADAVIT

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 Offerer: _____

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

00145-12

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:

2020 Lift Station Mitigation Pkg 4 - Lift Station 4 Construction Services

- 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:

2020 Station Mitigation Package 4 - Lift Station 4 Construction Services

ARTICLE II: DESIGN PROFESSIONAL

- 2.1 The Project has been designed by 5ENGINEERING, LLC, 11200 Westheimer Rd., Suite 353, Houston, TX 77042, Houston, TX 77042, 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 THREE HUNDRED AND SIXTY-FIVE (365) CALENDAR Days after the date when the Contract Time commences to run as provided by the General Conditions, except for the

standby generator work which shall be Substantially Complete within SIX HUNDRED (600) 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 THREE HUNDRED AND NINETY-FIVE (395) CALENDAR Days after the date when the Contract Time commences to run as provided by the General Conditions, except for the standby generator work which shall be have final completion within SIX HUNDRED AND THIRTY (630) 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 00300 OR 00305] – [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 an accordance with of 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 of 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 that 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 City and the Contractor concerning the Work consists of the following:

- 9.1 Bid Package (Cover Sheet and numbered sheets).
- 9.2 Invitation to Bid
- 9.3 Addenda as issued, with Acknowledgement of Addenda if applicable
- 9.4 Insurance Requirements
- 9.5 Child Support Affidavit
- 9.6 Unit Price Bid Form
- 9.7 Post-Bid Procedures
- 9.8 Standard Agreement for Contracting Services (this agreement)
- 9.9 Texas Workers Compensation
- 9.10 Wage Scale

- 9.11 Affidavit of Insurance, and Certificates of Insurance
- 9.12 Alcohol and Drug Free Workplace Policy.
- 9.13 Construction Storm Preparation Policy.
- 9.14 Hazardous Communications Program Requirement Agreement.
- 9.15 Homeland Security Policy.
- 9.16 Texas Ethics Commission Form 1295.
- 9.17 Performance Bond, included herein.
- 9.18 Payment Bond, included herein.
- 9.19 General Conditions.
- 9.20 Supplemental Conditions.
- 9.21 Technical Specifications Divisions 1 through 16
- 9.22 Any modification, including Change Orders, duly delivered after Execution of the Agreement.

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 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 – Federal Contract Required Clauses (attached to the end of this agreement).

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

Federal Contract Required Clauses

The following contract clauses are included in this Agreement, where applicable, pursuant to 2 C.F.R. 200.326 and 2 C.F.R. Part 200, Appendix II. Violations of law will be referred to the proper authority in the applicable jurisdiction. For purposes these clauses, the Contractor may also be referred to as "contractor" or "prime contractor" and the City of Friendswood may also be referred to as "subrecipient." All Prime Contractors awarded contracts by the Subrecipient which are federally funded, in whole or in part, are required to comply with the provisions below. Additionally, Prime Contractors with the Subrecipient are required to include the provisions below in any contracts executed with subcontractors performing the scope of work and shall pass these requirements on to its subcontractors and third-party contractors, as applicable. In addition to other provisions required by the relevant Federal agency, State of Texas, or City of Friendswood, all contracts made by the Subrecipient under the Federal award shall contain provisions covering the following, as applicable.

CONTENTS

1. Access to Records
2. Affirmative Socioeconomic Steps
3. Byrd Anti-Lobbying Agreement
4. Clean Air Act & Federal Water Pollution Control Act
5. Federal Water Pollution Control Act
6. Compliance with Federal Law, Regulations, and Executive Orders
7. Contract Work Hours and Safety Standards Act
8. Debarment and Suspension
9. Department of Homeland Security Seal, Logo, and Flags
10. Domestic Preferences for Procurement
11. Energy Efficiency
12. Hold Harmless Agreement
13. Copyright and Data Rights
14. No Obligation by Federal Government
15. Potential Conflicts of Interest
16. Procurement of Recovered Materials
17. Program Fraud and False or Fraudulent Statements or Related Acts
18. Prohibition of Contracting for Covered Telecommunications Equipment or Services
19. Termination for Cause & Convenience
20. Whistleblower Protection Act
21. Equal Employment Opportunity
22. Davis-Bacon and Copeland Anti-Kickback Act
23. Rights to Inventions made under a Contract or Agreement
24. Additional FEMA Requirements.

1. ACCESS TO RECORDS (Disaster Recovery Reform Act of 2018) The following access to records requirements apply to this Agreement:
 - a. The Contractor agrees to provide the City of Friendswood, the State of Texas, the FEMA Administrator, the Comptroller General of the United States, or any of their authorized representatives access to any books, documents, papers, and records of the Contractor which are directly pertinent to this Contract for the purposes of making audits, examinations, excerpts, and transcriptions.
 - b. The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed.
 - c. The Contractor agrees to provide the FEMA Administrator or his authorized representatives access to construction or other work sites pertaining to the work being completed under the Contract.
 - d. In compliance with the Disaster Recovery Act of 2018, the City of Friendswood and the Contractor acknowledge and agree that no language in this Contract is intended to prohibit audits or internal reviews by the FEMA Administrator or the Comptroller General of the United States.
2. AFFIRMATIVE SOCIOECONOMIC STEPS
 - a. If subcontracts are to be let, the prime contractor is required to take all necessary steps identified in 2 C.F.R. § 200.321(b)(1)-(5) to ensure that small and minority businesses, women's business enterprises, and labor surplus area firms are used when possible.
 - b. These affirmative steps shall include:
 - (1) Placing qualified small and minority businesses and women's business enterprises on solicitation lists;
 - (2) Assuring that small and minority businesses, and women's business enterprises are solicited whenever they are potential sources;
 - (3) Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses, and women's business enterprises;
 - (4) Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority businesses, and women's business enterprises; and
 - (5) Using the services and assistance, as appropriate, of such organizations as the Small Business Administration and the Minority Business Development Agency of the Department of Commerce.
 - c. The State of Texas maintains a Historically Underutilized Business Program, which identifies any business at least 51 percent owned by an Asian Pacific American, Black American, Hispanic American, Native American, American woman and/or Service Disabled Veteran, who reside in Texas and actively participate in the control, operations and management of the entity's affairs as a Historically Underutilized Business (also considered MWBE). Contractors who wish to check the status of a firm may visit <https://comptroller.texas.gov/purchasing/vendor/hub/>.
 - d. Contractors and subcontractors are required to facilitate Minority & Women-Owned Business Enterprise participation. Contractors are encouraged to utilize MWBEs / HUB firms as subcontractors, subconsultants, or suppliers in order to comply with the requirements and may check for firms who perform relevant work by searching <https://comptroller.texas.gov/purchasing/vendor/hub/>.
 - e. Contractor and subcontractors must facilitate Minority & Women-Owned Business Enterprise participation and take all affirmative steps to utilize MWBEs / HUB firms as subcontractors, subconsultants, or suppliers throughout the life of the Contract.

3. **BYRD ANTI-LOBBYING AGREEMENT 31 U.S.C. § 1352 (as amended)**
Contractors who apply or bid for an award of \$100,000 or more shall file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, officer or employee of Congress, or an employee of a Member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. § 1352. Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient who in turn will forward the certification(s) to the awarding agency.
4. **CLEAN AIR ACT & FEDERAL WATER POLLUTION CONTROL ACT Clean Air Act**
 - a. The contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. § 7401 et seq.
 - b. The contractor agrees to report each violation to the City of Friendswood and understands and agrees that the City of Friendswood will, in turn, report each violation as required to assure notification to the Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office.
 - c. The contractor agrees to include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with Federal assistance provided by FEMA.
5. **FEDERAL WATER POLLUTION CONTROL ACT**
 - a. The Contractor agrees to comply with all applicable standards, orders, or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et seq.
 - b. The Contractor agrees to report each violation to the City of Friendswood and understands and agrees that the City of Friendswood will, in turn, report each violation as required to assure notification to the Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office.
 - c. The Contractor agrees to include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with Federal assistance provided by FEMA.
6. **COMPLIANCE WITH FEDERAL LAW, REGULATIONS, AND EXECUTIVE ORDERS**
This is an acknowledgement that FEMA financial assistance will be used to fund all or a portion of the Contract. The Contractor will comply with all applicable Federal law, regulations, executive orders, FEMA policies, procedures, and directives.
7. **CONTRACT WORK HOURS AND SAFETY STANDARDS ACT (40 U.S.C. §§ 3701-3708; and 2 C.F.R. Appendix II to Part 200 (E))**
Compliance with the Contract Work Hours and Safety Standards Act.
 - a. *Overtime Requirements* – No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

- b. *Violation; liability for unpaid wages; liquidated damages.* In the event of any violation of the clause set forth in paragraph (a) of this section the Contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (a) of this section, in the sum of \$29 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (a) of this section.
- c. *Withholding for unpaid wages and liquidated damages.* The City of Friendswood shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b) of this section.
- d. *Subcontracts.* The Contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (a) through (d) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (a) through (d) of this section.

Further Compliance with the Contract Work Hours and Safety Standards Act.

- a. The Contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the Contract for all laborers and mechanics, including guards and watchmen, working on the Contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid.
- b. Records to be maintained under this provision shall be made available by the Contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the Department of Homeland Security, the Federal Emergency Management Agency, and the Department of Labor, and the Contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

8. DEBARMENT AND SUSPENSION

- a. This Contract is a covered transaction for purposes of 2 C.F.R. pt. 180 and 2 C.F.R. pt. 3000. As such, the contractor is required to verify that none of the contractor's principals (defined at 2 C.F.R. § 180.995) or its affiliates (defined at 2 C.F.R. § 180.905) are excluded (defined at 2 C.F.R. § 180.940) or disqualified (defined at 2 C.F.R. § 180.935).
- b. The contractor must comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C, and must include a requirement to comply with these regulations in any lower tier covered transaction it enters into.
- c. This certification is a material representation of fact relied upon by the State of Texas and the City of Friendswood. If it is later determined that the contractor did not comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C, in addition to remedies available

to the State of Texas and the City of Friendswood, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment.

- d. The bidder or Contractor agrees to comply with the requirements of 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or Contractor further agrees to include a provision requiring such compliance in its lower tier covered transactions.
9. **DEPARTMENT OF HOMELAND SECURITY SEAL, LOGO, AND FLAGS**
The Contractor shall not use the Department of Homeland Security (DHS) seal(s), logos, crests, or reproductions of flags or likenesses of DHS agency officials without specific FEMA pre-approval. The Contractor shall include this provision in any subcontracts.
10. **DOMESTIC PREFERENCE FOR PROCUREMENT (2 C.F.R. § 200.322)**
As appropriate, and to the extent consistent with law, the Contractor should, to the greatest extent practicable, provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States. This includes, but is not limited to iron, aluminum, steel, cement, and other manufactured products.

For purposes of this clause: Produced in the United States means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States.

Manufactured products mean items and construction materials composed in whole or in part of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber.
11. **ENERGY EFFICIENCY (42 U.S.C. 6201 and 2 C.F.R. 200 APPENDIX II (H))**
If applicable, Contractor must comply with the mandatory standards and policies relating to energy efficiency, which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (42 U.S.C. 6201).

Contractor must include this provision in all contracts between itself and any subcontractors in connection with the services performed under this Contract.
12. **HOLD HARMLESS AGREEMENT**
Contractor shall indemnify, defend, and hold harmless the Subrecipient and/or the City of Friendswood from all claims for personal injury, death and/or property damage resulting directly or indirectly from Contractor's performance.

Contractor shall procure and maintain, with respect to the subject matter of this solicitation, appropriate insurance coverage including, at a minimum, public liability, and property damage with adequate limits to cover Contractor's liability as may arise directly or indirectly from work performed under terms of this solicitation. Certification of such coverage must be provided to the Subrecipient upon request.
13. **COPYRIGHT AND DATA RIGHTS**
License and Delivery of Works Subject to Copyright and Data Rights
The Contractor grants to the City of Friendswood a paid-up, royalty-free, nonexclusive, irrevocable, worldwide license in data first produced in the performance of this contract to

reproduce, publish, or otherwise use, including prepare derivative works, distribute copies to the public, and perform publicly and display publicly such data. For data required by the contract but not first produced in the performance of this contract, the Contractor will identify 75 See 17 U.S.C. § 102. Contract Provisions Guide 35 such data and grant to the City of Friendswood or acquires on its behalf a license of the same scope as for data first produced in the performance of this contract. Data, as used herein, shall include any work subject to copyright under 17 U.S.C. § 102, for example, any written reports or literary works, software and/or source code, music, choreography, pictures or images, graphics, sculptures, videos, motion pictures or other audiovisual works, sound and/or video recordings, and architectural works. Upon or before the completion of this contract, the Contractor will deliver to the City of Friendswood data first produced in the performance of this contract and data required by the contract but not first produced in the performance of this contract in formats acceptable by the City of Friendswood.

14. NO OBLIGATION BY FEDERAL GOVERNMENT

The federal government is not a party to this Contract and is not subject to any obligations or liabilities to the non- federal entity, contractor, or any other party pertaining to any matter resulting from the Contract.

15. POTENTIAL CONFLICTS OF INTEREST

Pursuant to 2 C.F.R. 200.112, Contractor must comply with disclosure requirements in accordance with Texas Local Government Code, Chapter 176. Contractor shall not use funds to directly or indirectly pay any person for influencing or attempting to influence any public employee or official in connection with the awarding of any contract or the extension, continuation, renewal, amendment or modification of any contract. By law, the Conflict of Interest Questionnaire (provided by the Texas Ethics Commission at www.ethics.state.tx.us) must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the Contractor becomes aware of facts that require the statement to be filed.

This law requires persons desiring to do business with the City to disclose any gifts valued in excess of \$100 given to any City Official or the City Official's family member, or employment of any City Official or the City Official's family member during the preceding twelve (12) month period. The disclosure questionnaire must be filed with the Friendswood City Secretary's Office. Refer to Texas Local Government Code, Chapter 176 for the details of this law.

An outside consultant or contractor is prohibited from submitting a response for services on a Subrecipient project of which the consultant or contractor was a designer or other previous contributor, or was an affiliate, subsidiary, joint venturer or was in any other manner associated by ownership to any party that was a designer or other previous contributor. If such a consultant or contractor submits a prohibited response, that response shall be disqualified on the basis of conflict of interest, no matter when the conflict is discovered by the Subrecipient or City of Friendswood.

16. PROCUREMENT OF RECOVERED MATERIALS (2 C.F.R. Part 200, Appendix II(J); and 2 C.F.R. §200.323)

In the performance of this Contract, the Contractor shall make maximum use of products containing recovered materials that are EPA-designated items unless the product cannot be acquired—

- a. Competitively within a timeframe providing for compliance with the contract performance schedule;
- b. Meeting contract performance requirements; or
- c. At a reasonable price.

Information about this requirement, along with the list of EPA designated items, is available at EPA's Comprehensive Procurement Guidelines web site, <https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program>. The Contractor also agrees to comply with all other applicable requirements of Section 6002 of the Solid Waste Disposal Act.

17. PROGRAM FRAUD AND FALSE OR FRAUDULENT STATEMENTS OR RELATED ACTS (31 U.S.C. 3801 et seq.)

The Contractor acknowledges that 31 U.S.C. Chap. 38 (Administrative Remedies for False Claims and Statements) applies to the Contractor's actions pertaining to this contract.

18. PROHIBITION ON CONTRACTING FOR COVERED TELECOMMUNICATIONS EQUIPMENT OR SERVICES

a. *Definitions.* As used in this clause, the terms backhaul; covered foreign country; covered telecommunications equipment or services; interconnection arrangements; roaming; substantial or essential component; and telecommunications equipment or services have the meaning as defined in FEMA Policy 405-143-1, Prohibitions on Expending FEMA Award Funds for Covered Telecommunications Equipment or Services (Interim), as used in this clause—

b. *Prohibitions.*

- (1) Section 889(b) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019, Pub. L. No. 115-232, and 2 C.F.R. § 200.216 prohibit the head of an executive agency on or after Aug. 13, 2020, from obligating or expending grant, cooperative agreement, loan, or loan guarantee funds on certain telecommunications products or from certain entities for national security reasons.
- (2) Unless an exception in paragraph (c) of this clause applies, the Contractor and its subcontractors may not use grant, cooperative agreement, loan, or loan guarantee funds from the Federal Emergency Management Agency to:
 - (i) Procure or obtain any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology of any system;
 - (ii) Enter into, extend, or renew a contract to procure or obtain any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology of any system;
 - (iii) Enter into, extend, or renew contracts with entities that use covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system; or
 - (iv) Provide, as part of its performance of this Contract, subcontract, or other contractual instrument, any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system.

c. *Exceptions.*

- (1) This clause does not prohibit contractors from providing—
 - (i) A service that connects to the facilities of a third-party, such as backhaul, roaming, or interconnection arrangements; or
 - (ii) Telecommunications equipment that cannot route or redirect user data traffic or permit visibility into any user data or packets that such equipment transmits or otherwise handles.

- (2) By necessary implication and regulation, the prohibitions also do not apply to:
 - (i) Covered telecommunications equipment or services that:
 - i. Are not used as a substantial or essential component of any system; and
 - ii. Are not used as critical technology of any system.
 - (ii) Other telecommunications equipment or services that are not considered covered telecommunications equipment or services.
- d. *Reporting requirement.*
 - (1) In the event the Contractor identifies covered telecommunications equipment or services used as a substantial or essential component of any system, or as critical technology as part of any system, during contract performance, or the Contractor is notified of such by a subcontractor at any tier or by any other source, the Contractor shall report the information in paragraph (d)(2) of this clause to the recipient or subrecipient, unless elsewhere in this Contract are established procedures for reporting the information.
 - (2) The Contractor shall report the following information pursuant to paragraph (d)(1) of this clause:
 - (i) Within one business day from the date of such identification or notification: The contract number; the order number(s), if applicable; supplier name; supplier unique entity identifier (if known); supplier Commercial and Government Entity (CAGE) code (if known); brand; model number (original equipment manufacturer number, manufacturer part number, or wholesaler number); item description; and any readily available information about mitigation actions undertaken or recommended.
 - (ii) Within 10 business days of submitting the information in paragraph d(2)(i) of this clause: Any further available information about mitigation actions undertaken or recommended. In addition, the Contractor shall describe the efforts it undertook to prevent use or submission of covered telecommunications equipment or services, and any additional efforts that will be incorporated to prevent future use or submission of covered telecommunications equipment or services.
- e. *Subcontracts.* The Contractor shall insert the substance of this clause, including this paragraph e, in all subcontracts and other contractual instruments.

19. **TERMINATION FOR CAUSE & CONVENIENCE (2 C.F.R. Appendix II to Part 200 (A) and (B))**

- a. Pursuant to 2 C.F.R. Appendix II to Part 200 (A), Contracts for more than the simplified acquisition threshold currently set at \$150,000, which is the inflation adjusted amount determined by the Civilian Agency Acquisition Council and the Defense Acquisition Regulations Council (Councils) as authorized by 41 U.S.C. 1908, shall address administrative, contractual, or legal remedies in instances where contractors violate or breach contract terms, and provide for such sanctions and penalties as appropriate.
- b. Pursuant to 2 C.F.R. Appendix II to Part 200 (B), all contracts in excess of \$10,000 shall address termination for cause and for convenience by the non-Federal entity including the manner by which it will be effected and the basis for settlement. The Subrecipient shall have the right to terminate this Contract for cause and convenience.
- c. In the event of a failure by Contractor to satisfactorily perform the services specified herein and/or a default by Contractor in abiding by the other terms and conditions of this Contract, the Subrecipient may terminate the Contract on written notice to Contractor and Contractor shall be liable for all damages, costs, and expenses (including attorney fees) incurred by

City related to this default. Such termination is in addition to and not in lieu of any other remedies that the Subrecipient may have in law or equity. Administrative remedies for non-performance, violation or breach of contract terms, or termination of contract for default may include suspension and debarment. The Subrecipient may assess liquidated damages for failure to meet completion deadlines, contract breaches, or performance failures of the Contractor or its Subcontractors.

- d. Contractor shall be provided the opportunity to cure certain performance failures or instances of default as described in the contract documents. The legal dispute resolution process as applicable under the Texas Civil Practice and Remedies Code shall include, but is not limited to, Texas and Civil Practice and Remedies Section 38 – Attorney’s Fees, Texas Civil Practice and Remedies Section 41 – Damages, and Texas Civil Practice and Remedies Section 154 – General Provisions. The Subrecipient and Contractor(s) should attempt to resolve any claim for breach of contract made by Contractor, to the extent it is applicable to the Contract and not preempted by other law. Except as otherwise provided by law, nothing herein is a waiver by the City or the State of Texas of the right to seek redress in a court of law.

20. WHISTLEBLOWER PROTECTION ACT

- a. Contractor, subcontractors, and employees working on this Project shall be subject 41 U.S. Code § 4712, which requires that an employee of a contractor, subcontractor, grantee, or subgrantee or personal services contractor may not be discharged, demoted, or otherwise discriminated against as a reprisal for disclosing information that the employee reasonably believes is evidence of gross mismanagement of a Federal contract or grant, a gross waste of Federal funds, an abuse of authority relating to a Federal contract or grant, a substantial and specific danger to public health or safety, or a violation of law, rule, or regulation related to a Federal contract (including the competition for or negotiation of a contract) or grant.
- b. The Contractor shall inform its employees and subcontractors in writing, in the predominant language of the workforce, of employee whistleblower rights and protections under 41 U.S.C. 4712, as described in section 3.908 of the Federal Acquisition Regulation. The Contractor shall insert the substance of this clause, including this paragraph, in all subcontracts providing services for this Project.

21. EQUAL EMPLOYMENT OPPORTUNITY

- a. Standard. Except as otherwise provided under 41 C.F.R. Part 60, all contracts that meet the definition of "federally assisted construction contract" in 41 C.F.R. § 60-1.3 must include the equal opportunity clause provided under 41 C.F.R. § 60-1.4(b), in accordance with Executive Order 11246, Equal Employment Opportunity (30 Fed. Reg. 12319, 12935, 3 C.F.R. Part, 1964-1965 Comp., p.339), as amended by Executive Order 11375, Amending Executive Order 11246 Relating to Equal Employment Opportunity, and implementing regulations at 41C.F.R. Part 60 (Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor). See 2 C.F.R. Part 200, Appendix II, ¶ C.
- b. Applicability.
This requirement applies to all FEMA grant and cooperative agreement programs.
- c. Key Definitions.
 - 1. Federally Assisted Construction Contract. The regulation at 41 C.F.R. § 60-1.3 defines a "federally assisted construction contract" as any agreement or modification thereof between any applicant and a person for construction work which is paid for in whole or in part with funds obtained from the Government or borrowed on the credit of the Government pursuant to any federal program involving a grant, contract, loan, insurance, or guarantee, or undertaken pursuant

- to any federal program involving such grant, contract, loan, insurance, or guarantee, or any application or modification thereof approved by the Government for a grant, contract, loan, insurance, or guarantee under which the applicant itself participates in the construction work.
2. Construction Work. The regulation at 41 C.F.R. § 60-1.3 defines "construction work" as the construction, rehabilitation, alteration, conversion, extension, demolition or repair of buildings, highways, or other changes or improvements to real property, including facilities providing utility services. The term also includes the supervision, inspection, and other onsite functions incidental to the actual construction.
 3. Contract. The regulation at 41 C.F.R. § 60-1.3 defines contract as "any Government contract or subcontract or any federally assisted construction contract or subcontract.
 4. Additional definitions pertaining to this contract provision can be found at 41 C.F.R. § 60-1.3.
- d. The regulation at 41 C.F.R. § 60-1.4(b) requires, except as otherwise provided or exempted in 41 C.F.R. Part 60, the insertion of the following contract clause: "During the performance of this contract, the contractor agrees as follows:: "During the performance of this Contract, the Contractor agrees as follows:
1. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be 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. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
 2. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.
 3. The contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing,

- or action, including an investigation conducted by the employer, or is consistent with the contractor's legal duty to furnish information.
4. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
 5. The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
 6. The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
 7. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other Contract Provisions Guide 12 sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.
 8. The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the contractor may request the United States to enter into such litigation to protect the interests of the United States. The applicant further agrees that it will be bound by the above equal opportunity clause with respect to its own employment practices when it participates in federally assisted construction work: Provided, that if the applicant so participating is a state or local government, the above equal opportunity clause is not applicable to any agency, instrumentality or subdivision of such government which does not participate in work on or under the contract.

The applicant agrees that it will assist and cooperate actively with the administering agency and the Secretary of Labor in obtaining the compliance of contractors and subcontractors with the equal opportunity clause and the rules, regulations, and relevant orders of the Secretary of Labor, that it will furnish the administering agency and the Secretary of Labor such information as they may require for the supervision of such compliance, and that it will otherwise assist the administering agency in the discharge of the agency's primary responsibility for securing compliance. The applicant further agrees that it will refrain from entering into any contract or contract modification subject to Executive Order 11246 of September 24, 1965, with a contractor debarred from, or who has not demonstrated eligibility for, Government contracts and federally assisted construction contracts pursuant to the Executive Order and will carry out such sanctions and penalties for violation of the equal opportunity clause as may be imposed upon contractors and subcontractors by the administering agency or the Secretary of Labor pursuant to Part II, Subpart D of the Executive Order. In addition, the applicant agrees that if it fails or refuses to comply with these undertakings, the administering agency may take any or all of the following actions: Cancel, terminate, or suspend in whole or in part this grant (contract, loan, insurance, guarantee); refrain from extending any further assistance to the applicant under the program with respect to which the failure or refund occurred until satisfactory assurance of future compliance has been received from such applicant; and refer the case to the Department of Justice for appropriate legal proceedings.”

22. DAVIS-BACON ACT AND COPELAND ANTI-KICKBACK ACT.

- a. Applicability of Davis-Bacon Act.
The Davis-Bacon Act only applies to the Emergency Management Preparedness Grant Program, Homeland Security Grant Program, Nonprofit Security Grant Program, Tribal Homeland Security Grant Program, Port Security Grant Program, and Transit Security Grant Program. It does not apply to other FEMA grant and cooperative agreement programs, including the Public Assistance Program.
- b. All prime construction contracts in excess of \$2,000 awarded by non-federal entities must include a provision for compliance with the Davis-Bacon Act (40 U.S.C. §§ 3141-3144 and 3146-3148) as supplemented by Department of Labor regulations at 29 C.F.R. Part 5 (Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction). See 2 C.F.R. Part 200, Appendix II, ¶ D.
- c. In accordance with the statute, contractors must be required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week.
- d. The non-federal entity must place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation. The decision to award a contract or subcontract must be conditioned upon the acceptance of the wage determination. The non-federal entity must report all suspected or reported violations to the federal awarding agency.
- e. In contracts subject to the Davis-Bacon Act, the contracts must also include a provision for compliance with the Copeland "Anti-Kickback" Act (40 U.S.C. § 3145), as supplemented by Department of Labor regulations at 29 C.F.R. Part 3 (Contractors and Subcontractors

on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States). The Copeland Anti-Kickback Act provides that each contractor or subrecipient must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-federal entity must report all suspected or reported violations to FEMA.

- f. The regulation at 29 C.F.R. § 5.5(a) does provide the required contract clause that applies to compliance with both the Davis-Bacon and Copeland Acts. However, as discussed in the previous subsection, the Davis-Bacon Act does not apply to Public Assistance recipients and subrecipients. In situations where the Davis-Bacon Act does not apply, neither does the Copeland "Anti-Kickback Act." However, for purposes of grant programs where both clauses do apply, FEMA requires the following contract clause:

"Compliance with the Copeland "Anti-Kickback" Act.

1. Contractor. The Contractor shall comply with 18 U.S.C. § 874, 40U.S.C. § 3145, and the requirements of 29 C.F.R. pt. 3 as may be applicable, which are incorporated by reference into this contract.
2. Subcontracts. The Contractor or subcontractor shall insert in any subcontracts the clause above and such other clauses as FEMA may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all of these contract clauses.
3. Breach. A breach of the contract clauses above may be grounds for termination of the contract, and for debarment as a contractor and subcontractor as provided in 29 C.F.R. § 5.12."

23. RIGHTS TO INVENTIONS MADE UNDER A CONTRACT OR AGREEMENT.

- a. Stafford Act Disaster Grants. This requirement does not apply to the Public Assistance, Hazard Mitigation Grant Program, Fire Management Assistance Grant Program, Crisis Counseling Assistance and Training Grant Program, Disaster Case Management Grant Program, and Federal Assistance to Individuals and Households – Other Needs Assistance Grant Program, as FEMA awards under these programs do not meet the definition of "funding agreement."
- b. If the FEMA award meets the definition of "funding agreement" under 37 C.F.R. §401.2(a) and the non-federal entity wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that "funding agreement," the non-federal entity must comply with the requirements of 37 C.F.R. Part 401 (Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements), and any implementing regulations issued by FEMA. See 2 C.F.R. Part 200, Appendix II, ¶ F.
 - The regulation at 37 C.F.R. § 401.2(a) currently defines "funding agreement" as any contract, grant, or cooperative agreement entered into between any federal agency, other than the Tennessee Valley Authority, and any contractor for the performance of experimental, developmental, or research work funded in whole or in part by the federal government. This term also includes any assignment, substitution of parties, or subcontract of any type entered into for the performance of experimental, developmental, or research work under a funding agreement as defined in the first sentence of this paragraph.

24. ADDITIONAL FEMA REQUIREMENTS.

The Uniform Rules authorize FEMA to require additional provisions for non-federal entity contracts. FEMA, pursuant to this authority, requires or recommends the following:

A. Changes.

To be eligible for FEMA assistance under the non-federal entity's FEMA grant or cooperative agreement, the cost of the change, modification, change order, or constructive change must be allowable, allocable, within the scope of its grant or cooperative agreement, and reasonable for the completion of project scope.

FEMA recommends, therefore, that a non-federal entity include a changes clause in its contract that describes how, if at all, changes can be made by either party to alter the method, price, or schedule of the work without breaching the contract.

The language of the clause may differ depending on the nature of the contract and the end-item procured.

B. Access to Records.

All non-federal entities must place into their contracts a provision that all contractors and their successors, transferees, assignees, and subcontractors acknowledge and agree to comply with applicable provisions governing Department and FEMA access to records, accounts, documents, information, facilities, and staff. See DHS Standard Terms and Conditions, v 3.0, ¶ XXVI (2013).

C. The following provides a contract clause regarding access to records:

"Access to Records. The following access to records requirements apply to this contract:

1. The Contractor agrees to provide (insert name of state agency or local or Indian tribal government), (insert name of recipient), the FEMA Administrator, the Comptroller General of the United States, or any of their authorized representatives access to any books, documents, papers, and records of the Contractor which are directly pertinent to this Contract for the purposes of making audits, examinations, excerpts, and transcriptions.
2. The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed.
3. The Contractor agrees to provide the FEMA Administrator or his authorized representatives access to construction or other worksites pertaining to the work being completed under the Contract."

Certification for Contracts, Grants, Loans, and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any federal grant, the making of any federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any federal contract, grant, loan, or cooperative agreement.

If any funds other than federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S.C. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

The Contractor, _____, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C. Chap. 38, Administrative Remedies for False Claims and Statements, apply to this certification and disclosure, if any.

Signature of Contractor's Authorized Official

Name and Title of Contractor's Authorized Official

Date

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

Jildardo Arias, PE, CFM
Director of Engineering
(281) 993-3411
Daytime Phone Number

Contact #2 Name

Michael Medwedeff, CFM
Assistant Director of Engineering
(281) 993-3411
Daytime Phone Number

Contact #3 Name

Steve Vavrecka
Director of Public Works
(281) 993-3411
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 2020 LIFT STATION MITIGATION PACKAGE 4 - LIFT STATION 4, 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 – Texas Ethics Commission (FORM 1295)

Bid, CMR, CSP, RFP, or RFQ: [Advertisement Number]

Description of the service, product, or property being provided to the City of Friendswood: [Description].

Vendor Name: [Vendor Name].

Your Contract is being recommended to the City of Friendswood City Council for approval Monday, [INSERT MONTH] [INSERT DATE], [INSERT YEAR].

As you may or may not be aware, the 84TH Texas Legislature passed H.B. 1295 which added section 2252.908 to the Texas Government Code that now requires that a governmental entity receive a CERTIFICATE OF INTERESTED PARTIES – TEXAS ETHICS COMMISSION (FORM 1295) before entering into a Contract (new, amended, extended, or renewed) that:

1. Requires an action or vote of City Council before the Contract may be signed. A new filing must be completed for each awarded Contract (new, amended, extended, or renewed) requiring City Council approval; or
2. Has a value of at least One Million Dollars (\$1,000,000.00).

Accordingly, we need your assistance in complying with the new FORM 1295 requirements at your earliest convenience. Any delay in returning this form will result in the delay of approval and/or award of the contract. **If this form is not returned, the City of Friendswood will not proceed with the approval and/or award of the Contract.**

Effective January 1, 2016, business entities are responsible for complying with this law.

The Texas Ethics Commission made available on its website a new filing process that must be used to file FORM 1295.

Information regarding how to use the filing process is available on the Texas Ethics Commission website.

A Business Entity/Respondent must:

1. Use the online application to process the required information on FORM 1295;
2. Print a copy of the form which will contain a unique certificate number;
3. An authorized agent of the Respondent must sign the printed copy of the form;
4. Have the form notarized;
5. The completed FORM 1295 and certificate of filing must be files (scanning and emailing the form is sufficient) with the City of Friendswood prior to the signed Contract being submitted for City Council approval.

00280-1

If you have not already done so, your first step in completing FORM 1295 will be to create an account. For assistance on how to register and complete FORM 1295, we would highly encourage you to watch the short “Logging In the First Time-Business User” and “How to Create a Certificate” videos that are posted on the Texas Ethics Commission website. In addition, there are several other links on the website that might be helpful to you understanding and completing FORM 1295.

The City of Friendswood’s guidance in completing FORM 1295 is as follows (Please note that this is **NOT** legal advice):

1. Who is the contract with – click “Other Governmental Entity”.
2. Agency/Entity Name – City of Friendswood.
3. Contract ID Number – Enter the Contract Number at the top of this page.
4. Signature, Printed Name, and Title of Officer administering the Oath – Notary.

With regards to listing your business entity’s Interested Parties, the Texas Ethics Commission defines the terms controlling interest and intermediary interest as follows:

“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 ten percent (10%);
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 ten (10) members; or
3. Serves as an officer of a business entity that has four (4) or fewer officers, or serves as one (1) of the four (4) officers most highly compensated by a business entity that has more than four (4) officers.

“Intermediary Interest” means a person who actively participates in facilitating a contract or negotiating terms of a contract with a governmental entity or state agency, including a broker, intermediary, advisor, attorney, or representative of or agent for the business entity who meets all of the following conditions:

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 location of FORM 1295 on the Texas Ethics Commission Website can be found at the following link:

https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm

END OF DOCUMENT

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 2020 LIFT STATION MITIGATION PACKAGE 4 - LIFT STATION 4, 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 2020 LIFT STATION MITIGATION PACKAGE 4 - LIFT STATION 4, 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

SUPPLEMENTAL CONDITIONS

1. GENERAL

The Provisions of this Section of the Technical Specifications shall govern in the event of any conflict between them and General Conditions.

2. DESIGN PROFESSIONAL

The words "Design Professional" in these Technical Specifications shall be understood as referring to [INSERT DESIGN PROFESSIONAL'S NAME AND ADDRESS], Design Professional of the City, or such other Design Professional, or persons as may be authorized by the City to act in any particular position.

3. LOCATION OF THE PROJECT

This project is located in Friendswood, Texas, [INSERT COUNTY] County. Map showing the general location of this project is included in the Drawings.

4. CONSTRUCTION IN PUBLIC STREETS AND PRIVATE DRIVES

- A. No public road shall be entirely closed overnight. It shall be the responsibility of the Contractor to build and maintain all-weather bypasses and detours, if necessary, and to properly light, barricade and mark all bypasses and detours that might be required on and across the streets involved in the Work included in this Contract. The residents along the affected road(s) shall be contacted a minimum of forty-eight hours (48 Hrs) prior to the time the construction shall commence at their driveways or entrances and informed as to the length of time the driveways shall be closed.
- B. The Contractor shall make every effort to complete construction and allow immediate access to adjacent property at all driveway entrances located along the streets. The Owners or Tenants of commercial properties where access and/or entrance drives which shall be affected by construction shall be notified a minimum of twenty-four hours (24 Hrs) prior to the time the construction shall be started at their driveways or entrances and informed as to the length of time driveways shall be closed.
- C. During inclement weather the Contractor shall construct temporary gravel or shell crossings and wooden walkways to allow ingress and egress across excavated areas at no expense to the City and as directed by the Project Manager or the City's Design Professional.
- D. The Contractor shall be responsible for all streets and entrance reconstruction and repairs and maintenance of same for a period of one year (1 Yr) from the date of such reconstruction or Substantial Completion, whichever is longer. In the event the repairs and maintenance are not made immediately to the satisfaction of the City, and it becomes necessary for the City to make such repairs, the Contractor shall reimburse the City for the cost of such repairs.
- E. The Contractor shall, at all times, keep a sufficient width of the roadway clear of dirt and other material to allow the free flow of traffic. The Contractor shall assume any and all responsibility for damage, personal or otherwise, that may be caused by the construction along public streets or private drive.
- F. During the prosecution of the Work, the Contractor shall obstruct public travel

as little as possible and in no case shall there be less than twelve feet (12 Ft) in width of unobstructed roadway for traffic.

5. MAINTENANCE OF STORM SEWER, UTILITY CROSSINGS, AND EXISTING ROADWAYS

The Contractor shall maintain storm sewers, utilities, pipelines, and drainage facilities along the construction route at all times during construction at no additional expense to the City. Storm sewers and utilities crossing existing roadways shall be backfilled in accordance with these Technical Specifications and the Standard Details to an elevation six inches (6 In) below the elevation of the existing roadway. A temporary road patch of six inches (6 In) thick of compacted limestone base shall be constructed to or a little above the elevation of the existing roadway within the limits of the pavement removal at no additional cost to the City. The existing roadway shall be maintained throughout the construction. Pot hole appearing in the base or the existing pavement shall be deemed a hazard to the general public and shall be filled and maintained as directed by the Project Manager.

6. PUBLIC UTILITIES AND OTHER PROPERTY TO BE CHANGED

In case it is necessary to change or move the property of any owner or public utility, such property shall not be moved or interfered with until ordered to do so by the Project Manager. The right is reserved to the owner of public utilities to enter upon the limits of the project for the purpose of making such changes or repairs of their property that may be made necessary by performance of this Contract.

7. TEMPORARY CONSTRUCTION

No material which has been used by the Contractor for any temporary purpose whatever is to be incorporated in the permanent structure without written permission of the Project Manager.

8. PROJECT MAINTENANCE

The Contractor shall maintain and keep in good repair all work contemplated under these Drawings, Exhibits and/or Technical Specifications which shall include the maintenance and repair of all existing streets, storm sewer crossings, utility crossings, temporary crossings for access to adjacent property, wooden walkways, barricades, lights, danger signals and all work which is necessary for the well-being of the general public. In the event the Contractor fails to properly maintain the Work, the City shall make such repairs as are necessary and the cost of said repairs shall be deducted from payment due to the Contractor.

9. BORINGS

Wherever certain test borings are made on this site, the locations of such test borings and the information revealed by them is indicated on the Drawings and profiles for the project. These borings shall not be construed as a warranty on the part of the City of the exact nature of the subsurface conditions that will be encountered during construction of the Work. The information thus furnished is intended only as a guide to the Contractor in making their own investigations preliminary to submitting a price for the Work.

10. PROPERTY LINES AND MONUMENTS

The Contractor shall protect all property corner markers and when any such markers or monuments are in danger of being disturbed, they shall be properly referenced and if disturbed, shall be reset by a Professional Land Surveyor licensed by the State of Texas, at the expense of the Contractor.

11. EXISTING STRUCTURES

The Drawings show the locations of all known surface and subsurface structures. However, the City assumes no responsibility for failure to show any or all of these structures on the Drawings, or to show them in their exact locations. It is mutually agreed that such failure shall not be considered sufficient basis for claims for additional compensation for extra work or for increasing the pay quantities in any manner whatsoever, unless the obstruction encountered is such as to necessitate substantial changes in the lines or grades, or requires the building of special work, provisions which are not made in the Drawings and the Proposal, in which case the provisions in these Technical Specifications for extra work shall apply.

12. BARRICADES, LIGHTS, AND WATCHMEN

- A. Where the Work is carried on, in or adjacent to any street, alley or public place, the Contractor shall at their own cost and expense furnish and erect such barricades, fences, battery type flasher-markers and danger signals, shall provide watchmen, and shall provide such other precautionary measures for the protection of persons or property and the Work as are necessary. Barricades shall be painted using color that shall be visible at night and reflective. From sunset to sunrise the Contractor shall furnish and maintain at least one (1) battery type flasher-marker at each barricade and sufficient number of barricades shall be erected to keep vehicles from being driven on or into any work under construction. The Contractor shall furnish watchmen in sufficient numbers to protect the Work and the public.
- B. The Contractor shall be held responsible for all damage to the Work due to failure of barricades, signs, lights and watchmen to protect it, and whenever evidence is found of such damage, the Project Manager shall order the damaged portion to be immediately removed and replaced by the Contractor at no additional cost to the City. The Contractor's responsibility for the maintenance and repair of barricades, signs and lights, and for providing watchmen shall not cease until the project has been accepted by the City.
- C. Materials and equipment stored in or near the path of traffic shall be protected with red flags during the day and with lights during the night.

13. FENCES, DRAINAGE CHANNELS, AND CROP DAMAGE

- A. Boundary fences or other improvements removed to permit the installation of the Work shall be replaced in the same location and left in a condition as good or better than that in which they are found. This shall include landscaping, gardens, etc.
- B. Where surface drainage channels are disturbed or blocked during

- construction, final restoration to their original condition of grade and cross section shall be accomplished after the Work of construction is completed. Interim reshaping and cleanup shall occur immediately after trench backfilling.
- C. The Contractor shall not be held liable for unavoidable damage of crops provided such damage occurs within the construction easement provided by the City.
14. DISPOSAL OF WASTE AND SURPLUS EXCAVATION
- A. All trees, stumps, slashings, brush or other debris removed from the sites as a preliminary to the construction work shall be removed from the property and disposed of in a manner approved by the Project Manager.
- B. All excavated earth in excess of that required for backfilling shall be removed from the job site and disposed of in a satisfactory manner except in locations where, in the judgment of the Project Manager, it can be neatly spread over and along sites to form the finished contours.
15. WATER FOR CONSTRUCTION
- A. Water used for sprinkling, testing and flushing of waterlines or any other purpose incidental to this project, shall be furnished to the Contractor. The Contractor shall make necessary arrangements for securing and transporting said water and shall take said water in a manner and at such times that will not produce a harmful drain or decrease of pressure in the City's water system. Water shall not be used in a wasteful manner.
- B. Water shall be dispensed from a meter from the City' Department of Public Works. The Contractor shall not operate any valves on the existing water supply without a Public Works employee present. All water going into containers shall use a vacuum break.
- C. There shall be no jetting or flooding of trenches.
16. LIGHTS AND POWER
- The Contractor shall provide, at the Contractor's expense, electrical power, temporary lighting, and facilities required for the proper prosecution and inspection of the Work.
17. CLEANUP
- A. Cleanup shall follow the execution of the Work. At the conclusion of the Work, all tools, temporary structures, and materials belonging to the Contractor shall be promptly removed and all dirt, rubbish and other foreign substances shall be disposed of properly.
- B. The Contractor shall thoroughly clean all equipment and materials installed by the Contractor and shall deliver over such materials and equipment undamaged in a bright, clean polished and new appearing condition.
- C. During construction of the Work, the Contractor shall, at all times keep the site of the Work and adjacent premises as free of material, debris and rubbish, as is practicable and shall remove same from any portion of the site, if, in the opinion of the Project Manager, such material, debris or rubbish constitutes a nuisance or is objectionable.

- D. The Contractor shall remove from the site all of his surplus materials and temporary structures when no further need therefore develops.
18. **EXISTING UTILITIES, PIPELINES, AND SERVICE LINES**
The Contractor shall be responsible for the protection of all existing utilities, pipelines, and service lines crossed or exposed by the construction operations. Where existing utilities, pipelines, or service lines are cut, broken, or damaged, the Contractor shall replace or repair them with the same type of original material and construction, or better, at the Contractor's own cost, with the exception of those items included in the price schedule.
19. **POLES, SIGNS, GUY WIRES, ETC.**
A. All utility poles and guy wires, private sign posts, signs and guy wires, and similar private obstructions which interfere with the construction of this project shall be removed and replaced, or moved to new permanent locations by the owners thereof, at the Contractor's expense. No separate compensation shall be paid for this work, but the costs thereof shall be included in such contract pay items as are provided.
B. The removal and replacement of the City's street sign post and signs are the responsibility of the Contractor. The Contractor shall be responsible for all damage to street sign posts and signs within the limits of the Contractor's operations that remain in place or are removed and replaced. In the event street sign posts and/or signs are damaged or destroyed by the Contractor's operations, said sign posts, or signs shall be replaced by the Contractor at no cost to the City.
1) All signs on City Streets that are not Texas Department of Transportation (TxDOT) Highways shall be purchased directly from the Department of Public Works.
20. **SALVAGED MATERIALS**
All materials removed during the construction of the projects, and designation on the Drawings or by the Project Manager, as salvaged materials, shall be removed, cleaned, and stored as directed by the Project Manager. Salvaged materials shall be the property of the City.
21. **PROTECTION OF IMPROVEMENTS**
The Contractor shall be entirely responsible for the protection of all improvements that are not designated by the Project Manager to be removed for proper construction of the project; this shall include sidewalks, buildings, walls, existing inlets and manholes, underground utilities, shrubs trees, signs, sod and pavement.
22. **PROTECTION OF TREES**
No trees shall be removed or cut except upon the specific approval of the City. Trees adjacent to the Work shall be protected from all damage by construction operations and as specified in Tree and Plant Protection.
23. **PROTECTION AND ADJUSTMENT OF EXISTING WATER VALVE BOXES**

Water valve locations shall be furnished by the City prior to the grading operations. Protection of existing water valve boxes located within the limit of the Work shall subsequently be the responsibility of the Contractor. Failure to show water valve box locations on the Drawings does not relieve the Contractor of the responsibility to prevent damage to the valves and boxes. The Contractor shall adjust all water valve boxes which require adjustment to new pavement grade. Water valve boxes shall be adjusted as per Technical Specification 02310 – Adjusting Manholes, Inlets, and Valve Boxes to Grade.

24. ADJUSTMENT OF TOPS OF EXISTING SANITARY SEWER MANHOLES

Tops of existing sanitary sewer manholes shall be adjusted where necessary to match the grade of new pavement. Adjustment shall be made by breaking back the top portion of the manhole and rebuilding to conform to the new grade. Tops of manholes shall be adjusted as per Technical Specification 02310 – Adjusting Manholes, Inlets, and Valve Boxes to Grade.

25. PROTECTION AGAINST ACCIDENT TO EMPLOYEES AND THE PUBLIC

The Contractor and Contractor's Sureties shall indemnify, defend and save harmless the City and the City's Design Professional, and all their officers, agents and employees from all suits, actions and claims of any character, name and description brought for or on account of any injuries or damages received or sustained by any person or persons or property on account of any act, omission or fault of the Contractor, their agents or employees, in the execution of said Contract; or on account of the failure of the Contractor to provide the necessary barricades, warning lights or signs; and shall be required to pay any judgment, with costs, which may be obtained against the City and/or the City's Design Professional growing out of such injury or damage.

26. LINES AND GRADES

A. The City's Design Professional shall furnish survey control to enable the Contractor to set construction stakes for the Work. Said controls shall be one (1) horizontal control and one (1) vertical control. The Contractor shall be responsible for all construction staking. Any field conditions that appear to be in conflict with the Drawings shall be submitted to the City's Design Professional in writing with adequate time allowed the City's Design Professional to resolve the conflict. No compensation for surveying shall be made without prior written approval from the City and the City's Design Professional.

B. **THE FURNISHING OF THE CONTROL DOES NOT RELIEVE THE CONTRACTOR OF THE RESPONSIBILITY OF INSURING THAT THE WORK IS CONSTRUCTED TO THE LINES AND GRADES SHOWN ON THE DRAWINGS.**

27. AFFIDAVIT OF PAYMENT

A. Request for payment shall be accompanied by an Affidavit of Payment, duly signed, and if a Corporation attested to, stating that all cost of labor, material, equipment, taxes, etc., pertinent to this project, have been paid and are

current.

- B. The Final Payment, besides having the Document listed in Paragraph 27.A of Supplemental Conditions, shall also have filed Waiver and Release of Lien.

28. INTERRUPTION OF UTILITY SERVICES

Each and every Contractor and Subcontractor performing at the site of the Project shall not operate any valve or other control on existing systems and shall exercise care in performing work so as not to interrupt service. At house connections, every Contractor and Subcontractor performing at the site shall either lift trenching machine over lines or cut and reconnect with minimum interruption of service as approved by the City's Design Professional.

29. LOSSES FROM NATURAL CAUSES

Unless otherwise specified, all loss or damage to the Contractor arising out of the nature of the Work to be done, or from the action of the elements, or from any unforeseen circumstances in the prosecution of the same, or from unusual obstructions or difficulties which may be encountered in the prosecution of the Work, shall be sustained and borne by the Contractor at no additional cost to the City.

30. MAINTENANCE AND INSTRUCTION MANUALS

Furnish three (3) bound sets of Maintenance and Instruction Manuals. Bind manuals in volumes of not more than four inches (4 In) thick, in hard back nine inch by twelve inch (9 In x 12 In) binders. Include like equipment in one (1) volume with heavy duty dividers, separating equipment. Catalog and index all volumes. Operation and Maintenance Manuals or Bulletins shall include necessary data for reordering replacement parts, lubrications schedules, and procedures for required maintenance. These items shall be included but not limited to: exhaust fans, air conditioning units, louvers, generator sets, pumps, motors, variable speed drives, mechanical drives, electrical switchgear and controls, electrical fixtures, valves, instrumentation, chlorinators, meters, gauges and miscellaneous mechanical and electrical components supplied under this Contract.

31. SUBCONTRACTOR VALUES

The Contractor shall not employ Subcontractors whose aggregate value of work exceeds fifty percent (50%) if the total amount of the Contract Price as stipulated in the Standard Agreement.

32. PROJECT REPRESENTATIVE SERVICES

Project Representative Services shall be the responsibility of the Project Manager and these services shall be in accordance with the Standard Agreement between the City and the City's Design Professional. The Project Representative's duties shall include preparation of daily reports, determination that the project is proceeding in general compliance with the Contract Documents, measurement of material quantities and reporting to the Project Manager any work that should be stopped when it appears that the completed project may not comply with the requirements of the Contract Documents. The Project Representative shall be the liaison between the Contractor and the City's Design Professional and the City. The

Project Representative's responsibilities begin after the Contract is awarded and terminate after the Final Inspection.

33. CONTRACTOR SUBMITTED ALTERNATE DESIGNS

- A. If alternate design features are proposed for convenience of the Contractor, Contractor shall submit design calculations and detailed Drawings covering the proposed changes and related modifications of the Contract Drawings for review. Contractor shall make the Drawings the same size as the Contract Drawings and of comparable quality. The Contractor shall make payment to the City for all charges resulting from modifications, including engineering charges for checking such designs.
- B. If substitute items of equipment are allowed, and they vary materially from those shown on the Contract Drawings, Contractor shall prepare equipment data and detailed Drawings covering necessary modifications for the City's Design Professional for approval. Contractor shall make the Drawings the same size as the Contract Drawings and of comparable quality. The Contractor shall make payment to the City for all charges resulting from the modifications, including engineering charges for checking the modifications.

34. COST BREAKDOWN

Within fifteen days (15 D) after the execution of the Contract, Contractor shall submit, in acceptable form, a schedule showing subdivision of the Contract into various items of permanent construction, stating quantities and prices, as basis for computing values to the City of permanent usable parts of the facility to be paid for on monthly estimates.

35. MATERIALS AND EQUIPMENT

Contractor shall incorporate into the Work only new materials and equipment of domestic manufacture unless otherwise designated. Contractor shall store these materials and equipment in a manner to protect them from damages. The manner of protection is subject to the specific approval of the City's Design Professional. Pipe, fittings, equipment and other serviceable materials found on site of work or dismantled by reason of construction, remain property of the City. Contractor shall remove and deliver materials to the City at designated points. Contractor shall pay, at prevailing market price, for usable materials that are damaged through negligence.

36. SPECIAL SPECIFICATIONS AND SPECIAL PROVISIONS

Basic Technical Specification Items are those which follow prescribed general requirements. Special Specifications are those which supplement the Technical Specifications and are specific to this project, where there are no Technical Specifications covering certain portions of the Work. When necessary, Special Provisions are inserted to describe additional requirements appreciable to this Contract. Special Provisions are to be used in conjunction with the Technical Specification and Special Specification Items. In event of conflict, the requirements set forth in the Special Provisions as set forth will govern. In the event of conflict between the requirements shown on the Drawings and those contained in the

Technical Specifications, then the governing item shall be as specified in General Conditions.

37. AS-BUILT DIMENSIONS

The Contractor shall make daily measurements of facilities. On completion of the project, the Contractor shall furnish the City with one (1) set of blue lines, marked with red pencil, to show as-built dimensions and location of all the Work constructed.

38. ARCHEOLOGICAL CONSTRUCTIONS

- A. No activity which may affect a State Archeological Landmark is authorized until the City has complied with the provisions of the Antiquities Code of Texas. The City has previously coordinated with the appropriate agencies and impacts to known cultural or archeological deposits have been avoided or mitigated. However, the Contractor may encounter unanticipated cultural or archeological deposits during construction.
- B. If archeological sites or historic structures are discovered after construction operations are begun, the Contractor shall immediately cease operations in that particular area and notify the City and the Texas Historical Commission at (512) 463-6096. The Contractor shall take reasonable steps to protect and preserve the discoveries until they have been inspected by the City and the appropriate State Agency. The City shall promptly coordinate with the Texas Historical Commission and any other appropriate agencies to obtain any necessary approvals or permits to enable the Work to continue. The Contractor shall not resume work in the area of the discovery until authorized to do so by the City.
- C. Contractor, subcontractor and their respective employees shall have no claim to artifacts or treasure, found or discovered and shall assign any claim, as such, to the City.

39. ENDANGERED SPECIES

No activity is authorized that is likely to jeopardize the continued existence of a threatened or endangered species as listed or proposed for listing under the Federal Endangered Species Act (ESA), and/or the State of Texas Parks and Wildlife Code on Endangered Species, or to destroy or adversely modify the habitat of such species. If a threatened or endangered species is encountered during construction, the Contractor shall immediately cease work in the area of the encounter and notify the applicable State Agency. The actions shall include reporting the encounter to the U.S. Fish and Wildlife Service, and the Texas Parks and Wildlife Department, obtaining any necessary approvals or permits to enable the Work to continue, or implement other mitigative actions. The Contractor shall not resume construction in the area of the encounter until authorized to do so by the City.

40. OPERATION OF FACILITIES

The Contractor shall not operate, tap, or tamper with any existing facilities. Where construction involves operation of any existing facilities the City shall perform such operation. Any connection to existing equipment or systems to be schedule and approved in advance with performance to occur in the presence of the Project Manager.

41. SCOPE OF WORK

- A. Under this Contract, the Contractor shall furnish all materials, appliances, tools, equipment, transportation, services and all labor and superintendence necessary for construction of the Work as described in these Technical Specifications and as shown in the Drawings. The completed installation shall not lack any part which can be reasonably implied as necessary to its proper functioning or any subsidiary item which is customarily furnished, and the Contractor shall deliver the completed and operating installation to the City.
- B. The Work in general under this Contract includes, but is not limited to, that Work which is enumerated in the Unit Price Form or Total Stipulated Price Form of the Contract Documents.

END OF SECTION

**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. LS004 MIT 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 MITIGATION PACKAGE 4 - LIFT STATION 4

PROJECT NUMBER: LS004 MIT

BID No.: 2026-04

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

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 CONSTRUCTION of 2020 LIFT STATION MITIGATION PACKAGE 4 - LIFT STATION 4, 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**

SECTION 01110

SUMMARY OF WORK

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Summary of the Work including work by the City, City-furnished Products, work sequence, future work, Contractor use of Premises, special conditions for substantial completion and City occupancy.

1.2 REFERENCES

- A. CFTS – City of Friendswood Technical Specifications.
 - 1. Document 00145 – Unit Price Form.
 - 2. Document 00230 – Standard Agreement for Contracting Services.
 - 3. Section 00300 – General Conditions.
 - 4. Section 01030 – Work Restrictions.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. Work of the Contract is for the construction of the 2020 Lift Station Mitigation Improvements - Package 4 - Lift Station 4
- B. Lift Station No. 4: Work of the Contract generally comprises of the following:
 - 1. Demolition of existing wooden fence and gate.
 - 2. Demolition of wet well access hatch.
 - 3. Demolition of electrical panels, controls, and all appurtenances.
 - 4. Demolition of stand-by power generator and concrete pad.
 - 5. Demolition of existing asphalt driveway.
 - 6. Removal of airport beacon pole and demolition of pole foundation.
 - 7. Relocation of hose bib and installation of backflow preventer.
 - 8. Construction of 8-foot-tall wooden fence and gate.
 - 9. Construction of two 12-foot-wide concrete driveways and culverts.
 - 10. Installation of flood-tight pump access hatches.
 - 11. Construction of metal platform and stairs for stand-by generator and electrical and control panels including foundation.
 - 12. Construction of all instrumentation and electrical improvements as shown on the drawings, for a complete working system including, but not limited to instrumentation and control assemblies, service equipment, standby power generator, conduits, conductors,

SCADA capabilities, all related appurtenances, including studies, testing and coordination.

1.4 CASH ALLOWANCES

- A. Include the following specific Cash Allowances in Contract Price under provision of General Conditions:

1. None.

1.5 ALTERNATES

- A. From the following list of Alternates, amount included in Contract Price for only those Alternates accepted by the City and listed in the fully executed Document 00400 – Standard Agreement for Contracting Services, Article 5:

1. None.

1.6 CITY-FURNISHED PRODUCTS

- A. Items Furnished by the City for Installation and final connection by Contractor: Water meter.
- B. Contractor's Responsibilities:
1. Arrange and pay for product delivery to the site.
 2. Receive and unload products at the site; jointly with the City, inspect for completeness or damage.
 3. Handle, store, install, and finish products.
 4. Repair or replace damaged items.

1.7 WORK SEQUENCE

- A. Construct the Work in phases during the construction period; coordinate construction schedule and operations with the City:
1. Temporarily relocate electrical service panels and controls as needed to maintain the lift station in operation during construction of the proposed improvements.
- B. For projects with no phases, do not disturb more than 50% of total project linear feet of disturbed right-of-way and easement until the site is restored to the satisfaction of the Owner.
- C. Coordination of the Work: Refer to Section 01315 – Coordination and Meetings.

1.8 CONTRACTOR USE OF PREMISES

- A. Comply with procedures for access to the site and Contractor's use of rights-of-way as specified in 01140 – Work Restrictions.
- B. Construction Operations: Limited to the City's rights-of-way provided by the City and areas shown or described in the Contract Documents.
- C. Utility Outages and Shutdown: Provide a minimum of forty-eight hours (48 Hrs) notice to the City and private utility companies (when applicable), excluding weekends and holidays, in advance of required utility shutdown. Coordinate all work as required.

1.9 STREET CUT ORDINANCE

- A. Excavations on or under pavement in the City's right-of-way must have a permit. Comply with City of Friendswood, Texas Ordinance No. 2000-37, an ordinance amending Chapter 66 of the Code of Ordinances, Friendswood, Texas, relating to excavating in the public right-of-way.
- B. Comply with the latest edition of New Pavement Repair and Pavement Replacement details for street cuts.
- C. Quantities are included for street cut pavement repair and replacement in applicable Specification sections for Unit Price contracts.
- D. Include payment for street cut pavement repair and replacement in lump sum bid for Stipulated Price contracts.

1.10 WARRANTY

- A. Comply with warranty requirements in accordance with Section 00300 – General Conditions.

1.11 ADDITIONAL CONDITIONS FOR SUBSTANTIAL COMPLETION

- A. The Work of this contract shall be substantially completed within 365 calendar days except for the standby generator work which shall be substantially completed within 600 calendar days.
- B. The Work of this contract shall be finally completed within 395 calendar days except for the standby generator work which shall be finally completed within 630 calendar days.
- C. In addition to requirements outlined in Section 00300 – General

Conditions, for Contractor to be substantially complete with the Work and call for inspection by Project Manager to confirm, the following conditions must be met or completed:

1. Demonstrate the ability to receive and monitor video and Supervisory Control and Data Acquisition (SCADA) data from the lift station site.
2. All testing shall be completed and accepted by Project Manager.
3. All SCADA and security equipment shall be installed, accepted by manufacturer's representative, and approved for operation.
4. Draft O&M manuals shall be delivered to Project Manager.
5. Training shall be conducted, utilizing draft O&M manuals.
6. All Safety related work including pavement stripping, signing and signalization.
7. All safety-related systems and equipment shall be installed, accepted by manufacturer's representative, and approved for use.

- D. No additional condition described in Paragraph 1.10 may be included in Contractor's punch list.

PART II: PRODUCTS – NOT USED.

PART III: EXECUTION – NOT USED.

END OF SECTION

Section 05501

METAL FABRICATIONS

PART 1 GENERAL

1 SECTION INCLUDES

- A. Bolts, anchors, nuts, sleeves, concrete anchors, scheduled items, and other miscellaneous metal items not specifically included under other sections of these specifications.

2 UNIT PRICES

- A. No separate payment will be made for metal fabrications under this section. Include payment as part of the Work in appropriate sections.
- B. No separate payment will be made for metal fabrications under this section for the lift station and control building. Include payment in Lump Sum for Lift Station with price breakdown included in the Schedule of Values.
- C. Refer to Section 01270 - Measurement and Payment and Section 01292 - Schedule of Values.

3 REFERENCES

- A. ASTM A36 - Structural Steel.
- B. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- C. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- D. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- E. ASTM A276 - Stainless and Heat-Resisting Steel Bars and Shapes.
- F. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- G. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
- H. ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

- I. ASTM F593 - Stainless Steel Bolts, Hex Cap Screws, and Studs.
- J. ASTM F594 - Stainless Steel Nuts.
- K. AWS A2.0 - Standard Welding Symbols.
- L. AWS D1.1 - Structural Welding Code.
- M. SSPC - Steel Structures Painting Council.

4 SUBMITTALS

- A. Submit under provisions of Section 01330 –Submittal Procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
- C. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.
- D. Submit manufacturers technical literature and test reports showing certified capacities for concrete anchors.

5 QUALIFICATIONS

- A. Prepare Shop Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Texas.
- B. Welders' Certificates: Submit under provisions of Section 01330 - Submittal Procedures, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

6 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on Drawings.

PART 2 PRODUCTS

1 MATERIALS

- A. Steel Shapes and Plate: ASTM A36.
- B. Stainless Steel Sections: ASTM A276, Type 316 for non-welded items and Type 316L for welded items.

- C. Steel Tubing: ASTM A500 or A501, Grade B.
- D. Pipe: ASTM A53, Grade B Schedule 40.
- E. Bolts, Nuts, and Washers: ASTM A307 galvanized to ASTM A153 for galvanized components.
- F. Stainless Steel Bolts and Nuts: Bolts per ASTM F593, Type 316; nuts per ASTM F594, Type 316; UNC coarse threads.
- G. Concrete Anchors: Concrete anchors are inserted into holes drilled in hardened concrete and shall be one of the following types:
 - 1. Adhesive Anchors: Concrete anchors which are submerged, in splash zones, in enclosed spaces over liquids, or anchoring vibrating equipment shall be epoxy adhesive anchors. Adhesive anchors may be used at all locations where concrete anchors are required. Epoxy systems shall be Sika/FI System with Sikadur Injection Gel Epoxy, Master Builders Concessive Epoxy Cartridge Dispensing System and Concessive Paste LPL, or equal. Threaded rods shall be ASTM F593, Type 316 studs. Where adhesive anchors, or connected metal, are exposed to direct sunlight, the anchors shall be certified to maintain at least 90 percent of their rated strength (tested at 73 degrees F) when tested at 160 degrees F.
 - 2. Expansion Anchors: Where concrete anchors are indicated and adhesive anchors are not required, wedge type anchors made with ASTM A276, Type 316 Stainless Steel shall be used. Anchors shall be KWIK Bolt II By Hilti, Inc. or approved equal.
- H. Welding Materials: AWS D1.1; type required for materials being welded.
- I. Shop and Touch-Up Primer: compatible with systems specified in Section 09900 - Painting or Section 09901 - Protective Coatings.

2 FABRICATION

- A. Fit and shop assemble in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

3 FINISHES

- A. Prepare surfaces to be primed in accordance with SSPC SP 2.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Galvanize, after completion of welded fabrication, in accordance with ASTM A123, structural steel members. Provide minimum 1.25 oz/sq ft galvanized coating.

PART 3 EXECUTION

1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.
- C. All stainless steel threads to be coated with an anti-seizing compound prior to installing the nuts.

3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components indicated on shop drawings.

- D. Perform field welding in accordance with AWS D1.1.
- E. Obtain City Engineer approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed except surfaces to be in contact with concrete.

4 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

5 SCHEDULE

- A. The Schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.
- B. Joist Hangers: Joist strap anchors, fabricated with minimum 18 gage steel; galvanized finish.
- C. Lintels: As detailed; galvanized finish.
- D. Bollards: Steel pipe concrete filled with crowned cap; Prime paint finish.
- E. Ladder: As detailed; Galvanized finish.
- F. Burglar Bar Cage: Stainless steel bar assembly as detailed.

END OF SECTION

Section 09901

PROTECTIVE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparing surfaces, providing adequate conditions for proper workmanship, and furnishing and applying the protective coating materials required for metallic, concrete, masonry and plastic surfaces.
- B. Color code painting of piping and piping identification signs and markers.
- C. Refer to Section 09900 – Painting for Decorative and Protective Coatings to be used on Interior and Exterior Architectural Surfaces, such as wood, gypsum board and masonry.
- D. Refer to Section 09971 – Painting and Protective Coatings for Potable Water Storage Tanks for painting and protective coatings to be used on potable water storage tanks.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices
 - 1. No separate payment will be made for protective coatings unless specifically listed in Document 00410 – Bid Form. Include payment for protective coatings in unit prices for items to which coatings are applied.
 - 2. Measurement for protective coatings, when included as a separate pay item, is on a square-foot basis for completed protective coating systems.
 - 3. Refer to Section 01270 – Measurement and Payment for unit price procedures.

1.03 REFERENCES

- A. ANSI A13.1 – Color Schedule
- B. ANSI/AWWA C213 – Fusion-bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
- C. Federal Specification TT-P-28 – Paint, Aluminum, Heat Resisting 1200 degrees F
- D. Federal Standard 595A – Federal Standard Colors

- E. Military Specification DOD-P-23236 – Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast, Class 2
- F. NSF Standard 61 – Drinking Water System Components – Health Effects
- G. SSPC-PA 1 – Paint Application Specification No. 1 - Shop, Field and Maintenance Painting
- H. SSPC-PA 2 – Paint Application Specification No. 2 – Measurement of Dry Paint Thickness with Magnetic Gages
- I. SSPC-Paint 16 – Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint
- J. SSPC-SP 1 – Solvent Cleaning
- K. SSPC-SP 2 – Hand Tool Cleaning
- L. SSPC-SP 3 – Power Tool Cleaning
- M. SSPC-SP 5/NACE 1 – White Metal Blast Cleaning
- N. SSPC-SP 6/ NACE 3 – Commercial Blast Cleaning
- O. SSPC-SP 7/NACE 4 - Brush-Off Blast Cleaning
- P. SSPC-SP 10/NACE 2 – Near White Metal Blast Cleaning
- Q. SSPC-SP 11 – Power Tool Cleaning to Bare Metal
- R. SSPC-VIS 1-89 – Visual Standard for Abrasive Blast Cleaned Steel
- S. SSPC-VIS 3 – Visual Standard for Power-and Hand-Tool Cleaned Steel
- T. SSPC-QP 1 – Standard Procedure for Evaluating Qualifications of Painting Contractors
- U. SSPC-QP 2 – Standard Procedure for Evaluating Qualifications of Painting Contractors to Remove Hazardous Paint
- V. SSPC-SP12/NACE 5 – Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultrahigh-Pressure Water Jetting Prior to Recoating

1.04 DEFINITIONS

- A. Paint, coatings, or finishes as used in this Section include surface treatments, emulsions, enamels, paints, epoxies, polyurethanes, acrylics, zincs, and other protective coatings with the exceptions of galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.

- B. DFT means minimum dry film thickness.
- C. VOC means Volatile Organic Components

1.05 PERFORMANCE REQUIREMENTS

- A. See the Drawings and other Specifications to determine how coatings under this Section will be applied. Paint or coat new and modified surfaces in conformance with this Section.
- B. Coating system schedules summarize surfaces to be coated, required surface preparation, and coating systems to be applied. Coating notes on Drawings are used to show exceptions to schedules, to show or extend limits of coating systems, or to clarify or show details for application of coating systems.
- C. Do not apply protective coatings to the following surfaces unless specifically named or shown to be coated:
 - 1. Concrete
 - 2. Stainless steel, bronze, or brass
 - 3. Machined surfaces
 - 4. Grease fittings
 - 5. Glass
 - 6. Equipment nameplates
 - 7. Platform gratings, stair treads, door thresholds, and other walk surfaces
 - 8. Galvanized steel electrical conduit and associated galvanized and factory-coated junction boxes and electrical panels
 - 9. Galvanized surfaces inside buildings and not exposed to view
 - 10. Manhole and valve covers and rings, storm water inlet gratings, covers, and frames
- D. Provide decorative and protective coatings for interior architectural surfaces such as wood, gypsum board, and masonry in accordance with Section 09900 – Painting.

1.06 SUBMITTALS

- A. Make submittals in accordance with Section 01330 – Submittal Procedures.
- B. Submit the following information at least 10 days prior to protective coating work:
 - 1. Coating Materials List: Eight copies of a coating materials list naming the manufacturer and the coating number, keyed to the coating systems described in this Section. Submit the list prior to or at the time of sample submittal.
 - 2. Paint Manufacturer's Information: For each coating system to be used, submit the following data:
 - a) Paint manufacturer's Product Data Sheet for each product proposed, including statements on the suitability of the material for the intended use.

- b) Technical and performance information that demonstrates compliance with the system performance and material requirements.
 - c) Paint manufacturer's instructions and recommendations on surface preparation, application and curing.
 - d) Colors available for each product, where applicable.
 - e) Compatibility of shop and field applied coatings, where applicable.
 - f) Material Safety Data Sheets for each product used.
 - g) VOC of each paint or coating proposed, stated in grams per litre.
3. Samples
- a) Submit color samples of paint, finishes, and other coating materials on 8-1/2 inch by 11-inch sheet metal or heavy cardstock. Have each sheet completely coated over its entire surface with one protective coating material, type, and color.
 - b) Provide two sets of color samples to match each color selected by the City Engineer from the manufacturer's standard color sheets. If custom-mixed colors are indicated, prepare color samples using color formulations prepared to match the color samples furnished by the City Engineer.
 - c) Submit one 15-pound sample of each abrasive proposed to be used for surface preparation for submerged and severe service coating systems.

1.07 QUALIFICATIONS

- A. Submit five (5) references which show that the painting Contractor has previous successful experience with the indicated or comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the painting Contractor provided the protective coating. As an alternative, submit proof of certification in accordance with SSPC-QP 1.
- B. For any project which involves removal or repair of lead based paints, submit proof of certification in accordance with SSPC-QP 2.

1.08 ENVIRONMENTAL RESTRICTIONS

- A. Ventilate area where coating is being applied. Post and enforce NO SMOKING OR OPEN FLAME signs until coating has cured.
- B. Provide lighting level of 80-foot candles (860 1x) measured mid-height at substrate surface.
- C. Restrict worker access and construction traffic from area where coating is being applied or is curing.
- D. Comply with City of Friendswood and all applicable OSHA confined space entry regulations including but not limited to OSHA Permit-Required Confined Space Standard 1910.146.

1.09 WARRANTY INSPECTION AND MAINTENANCE

A. Warranty Inspection:

1. A warranty inspection may be conducted during the eleventh month following completion of coating and painting. The Contractor and a representative of the coating material manufacturer must attend the inspection. At the option of the City, the City may be represented by a NACE certified coating inspector.
2. The City Engineer may, by written notice to the Contractor, reschedule the warranty inspection to another date within the one-year correction period, or may cancel the warranty inspection altogether. Cancellation of the warranty inspection does not relieve the Contractor of his responsibilities under the Contract Documents.
3. Repair defective work discovered during the warranty inspection in accordance with these Specifications.

- B. Extended Maintenance of Chemical Tank Lining Systems: Promptly repair defects in the chemical resistant sheet lining system for a period of 2 years after the lining has been placed into service. Such maintenance includes repair of the chemical tank and any equipment or facilities damaged by the corrosive action of the chemicals.

PART 2 PRODUCTS

2.01 COATINGS CRITERIA

- A. Suitability: Use suitable coating materials as recommended by the manufacturer. Recommendations must be accompanied by test methods used to determine suitability and results of these tests.
- B. Compatibility: In any coating system, use only compatible materials from a single manufacturer. Give particular attention to compatibility of primers, intermediate coats and finish coats. If necessary, apply a barrier coat or tie coat between existing prime coat and subsequent field coats to ensure compatibility.
- C. Containers: Supply coating materials in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all plainly legible at the time of use.
- D. Colors: Use colors and shades of colors of all coats of paint as indicated on the coating schedules or as selected by the City Engineer. Make each coat a contrasting shade to the previous and following coats to facilitate inspection of surface coverage of each coat. The City Engineer will select finish colors from the manufacturer's standard color samples.
- E. Substitute or Equal Products:

1. To establish equality under Section 01630 – Product Substitution Procedures, furnish satisfactory documentation from the manufacturer of the proposed substitute product that the material meets the indicated requirements and is equivalent to or better in the following properties:
 - a) Resistance to abrasion and physical damage.
 - b) Resistance to chemical attack.
 - c) Life expectancy.
 - d) Ability to recoat in the future.
 - e) Solids content by volume.
 - f) Dry film thickness per coat.
 - g) Compatibility with other coatings.
 - h) Suitability for the intended service.
 - i) Temperature limitations in service and during application.
 - j) Type and quality of recommended undercoats and topcoats.
 - k) Ease of application.
 - l) Ease of repairing damaged areas.
 - m) Stability of colors.
 - n) VOC content expressed in grams per liter.
2. For substitutions, submit protective-coating materials which are standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, provide the City Engineer with the names of not less than 10 successful applications of the proposed manufacturer's products, which comply with these requirements. Applications must be in similar service environments to the job being contracted.

2.02 INDUSTRIAL COATING SYSTEMS

- A. Material Sources: Each of the following manufacturers is capable of supplying many of the specified industrial coating materials. Manufacturers and specific paint designations (numbers) are listed to indicate the required type and quality of coating. Contractors are to base their bid on the use of products supplied by one of the named manufacturers. These named manufacturers are designated to establish a level of acceptable product quality or manufacturing experience and are not to be construed as the only manufacturers of products acceptable for use. Other manufacturers will be considered on an individual basis, and may be submitted for consideration in accordance with Document 0700, Article 3.8, Product Options and Substitutions (excluding 3.8.3), Section 01330 – Submittal Procedures, Section 01630 – Products Substitution Procedures, and this Section.

1. AKZO/International Coatings
2. Ameron International
3. Carboline Coatings Company
4. Hempel Coatings USA, Inc.
5. ICI/Devroe Coatings
6. Sigma Coatings USA, Inc.
7. Tnemec Company
8. Sherwin Williams Co.

- B. System 1 – Aliphatic Polyurethane Finish Coat: Use a two-component aliphatic acrylic polyurethane coating that provides superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering, and has a minimum solids content of 58 percent by volume. As primer, use a rust inhibitive 2-component epoxy coating with minimum solids content of 66 percent by volume.
1. Prime Coat:
 - a) DFT = 4-6 mils (100-150 microns).
 - b) Products: Ameron 385, Carboline 893, Themec 69, VyGuard V75, SW Macropoxy 646 FC Epoxy, or equal.
 2. Finish Coats (one or more):
 - a) DFT = 2-4 mils (50-100 microns).
 - b) Products: Ameron 450 GL, Carboline 134 HG, Themec 74, VyGuard V54, Sherwin Williams Hi-Solids Polyurethane, or equal.
 3. Total System = 6-10 mils (150-250 microns).
 4. Apply more than one finish coat as necessary to produce a finish with uniform color and texture.
- C. System 2 – Inorganic Zinc/Epoxy Polyurethane: For prime coat, use a 2-component water or solvent-based inorganic zinc silicate which contains at least 85 percent of metallic zinc by weight in the dried film, and is recommended by the coating manufacturer as a primer for this system. As intermediate coat, use a high-build, 2-component epoxy with a solids content of at least 70 percent by volume. For finish coat, use a 2-component aliphatic acrylic or polyester polyurethane coating material that provides superior color and gloss retention, resistance to chemical fumes and severe weathering, and has a minimum solids content of 58 percent by volume.
1. Prime Coat:
 - a) DFT = 2.5-4.0 mils (65-100 microns).
 - b) Products: Ameron Dimetecote 21-5 or 21-9, Carbozinc 11 or D7WB, VyGuard 13F6 or 13F7, SW Zinc Clad II L.V. or equal.
 2. Intermediate Coat:
 - a) DFT = 4-6 mils (100-150 microns).
 - b) Ameron 385, Carboline 893, VyGuard V75, or equal.
 3. Finish Coats (one or more):
 - a) DFT = 2.5 to 4.0 mils (65-100 microns).
 - b) Ameron 450 GL, Carboline 134 HG, VyGuard V54, Sherwin Williams Hi-Solids Polyurethane, or equal.
 4. Total System DFT = 9-14 mils (225-600 microns).
 5. Apply intermediate coat in excess of 4 mils (100 microns) DFT using the mist coat/full coat technique to completely cover the inorganic zinc primer and prevent bubbling of the epoxy or polyurethane finish coat.
 6. Apply more than one finish coat as necessary to produce a finish with uniform color and texture.

7. If inorganic zinc primer is used as a pre-construction or shop-applied primer, and there are damaged or uncoated areas, spot blast the damaged areas with abrasive to an SSPC-SP 10 Near White Metal Standard and then coat with the specified material.
- D. System 3 – Inorganic Zinc: Use a 2-component water-based inorganic zinc silicate which contains at least 85 percent of metallic zinc by weight in the dried film.
1. Prime Coat and Finish Coat (one).
 - a) DFT = 2.5 to 4.0 mils (65-100 microns).
 - b) Products: Ameron Dimetcote 21-5, Carbozinc D7WB, VyGuard 13F6 or 13F7, S.W. Zinc Clad XI, or equal.
 2. Total System DFT = 2.5 to 4.0 mils (65-100 microns).
- E. System 4 – Acrylic Latex: Use a single component, water-based acrylic latex with a fungicide additive having a minimum solids content of 35 percent by volume. Apply a prime coat as recommended by manufacturer. Select coating material, which is available in ANSI safety colors.
1. Prime Coat
 - a) DFT = 2-3 mils (50-75 microns).
 - b) Products: Carboline D3358, Ameron 148, Hemucryl 1803, Sherwin Williams DTM Primer/Finish.
 2. Finish Coats (2 or more):
 - a) DFT = 6-8 mils (150-200 microns).
 - b) Products: Carboline D3359, Ameron 220, Hemucryl 4803, Sherwin Williams DTM Acrylic Coating or equal.
 3. Total System DFT = 8-11 mils (200-275 microns).
- F. System 5 – Epoxy: Use a two-component, rust inhibitive, polyamide-cured epoxy coating material with a recoatable finish that is available in a wide selection of colors. Use a coating with a minimum solid content of 66 percent by volume and resistant to service conditions of condensing moisture, splash and spillage of lubricating oils, and frequent washdown and cleaning.
1. Prime Coat:
 - a) DFT = 3-5 mils (75-125 microns).
 - b) Products: Ameron 385PA, Carboline 193, Tnemec 69, VyGuard V75, Sherwin Williams Macropoxy 646 FC, or equal.
 2. Prime Coat (where shop applied):
 - a) DFT = 3-5 mils (75-125 microns).
 - b) Products: Ameron 370, Carboline 193, Tnemec 161, VyGuard V75, Sherwin Williams Recoatable Epoxy Primer, or equal.
 3. Finish Coats (2 or more):
 - a) DFT = 5- 7 mils (125-175 microns).
 - b) Products: Ameron 385, Carboline 893, Tnemec 69, VyGuard V75, Sherwin Williams Macropoxy 646 FC, or equal.
 4. Total System DFT = 8-12 mils (200-300 microns).

- G. System 6 – Aliphatic Polyurethane, Fiberglass: Use a two-component aliphatic polyurethane coating material with superior color and gloss retention, resistance to splash from acid and alkaline chemicals, and resistance to chemical fumes and severe weathering. Use a primer, tie coat, or mist coat as recommended by the manufacturer.
1. Prime Coat (Tie Coat): Ameron 385, Carboline 893, Tnemec P66, VyGuard V75, Macropoxy 646 FC, or equal.
 2. Finish Coats (2 or more):
 - a) DFT = 2-4 mils (50-75 microns).
 - b) Products: Ameron Amersfield, Carbothane 134 HG, Tnemec 74, VyGuard V54, or equal.
- H. Section 7 – Alkyd Enamel: Use a high quality, gloss, or semi-gloss, medium long oil alkyd finish with a minimum solids content of 49 percent by volume. Apply primer as recommended by manufacturer.
1. Prime Coat:
 - a) DFT = 2-3 mils (50 to 75 microns).
 - b) Products: Ameron 5105, Carboline AD29, Tnemec P4-55, VyGuard 13R29, kem Kromik Universal, or equal.
 2. Finish Coats (2 or more):
 - a) DFT = 2-4 mils (50-75 microns).
 - b) Products: Ameron 5401HAS, Carboline GP62, Tnemec 2H, VyGuard V20, Sherwin Williams Industrial Enamel, or equal.
 3. Total System DFT = 4-7 mils (100-175 microns).
- I. System 8 – Aluminum Metal Isolation: Use one coat of a high-build polyamide epoxy paint.
1. Products: Tnemec P66, Ameron 385, Carboline 893, Tnemec P66, VyGuard V75, Sherwin Williams Macropoxy 646 FC, or equal.
 2. Total System DFT = 6-8 mils (150-200 microns).
- J. System 9 – Aluminum Silicone Resin: Use an aluminum silicone resin material suitable for a service temperature of up to 1000 degrees F (538 degrees C). Coating must comply with Federal Specification DOD-P-28.
1. Prime Coat and Finish Coat (2 or more):
 - a) DFT = 2-4 mils (50-100 microns)
 - b) Products: Tnemec 39-1061, Ameron 878, Carboline 4631, VyGuard V437A1, Sherwin Williams Steel Master 9500, or equal
 - c) Total System DFT = 2-4 mils (50-100 microns)

- K. System 10 – Zinc Rich Epoxy: Use a polyamide Epoxy resin material that contains at least 76 percent zinc in the dried film.

1. Prime Coat and Finish Coat (2 or more):
 - a) DFT = 3-5 mils (75-125 microns)
 - b) Products: Ameron 68HS, Carboline 858, VyGuard 13F4, Sherwin Williams Zinc Clad III, or equal
 - c) Total System DFT = 3-5 mils (75-125 microns)

2.03 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

- A. Material Sources: The manufacturers listed in this paragraph are materials, which satisfy the material descriptions of this paragraph and have a documented successful record for long-term submerged or severe service conditions. Proposed substitute products will be considered as indicated under paragraphs 2.01.5.
- B. System 100 – Amine-Cured Epoxy: Use a high-build amine-cured epoxy with a solids content of at least 80 percent by volume. Use a coating suitable for long-term immersion in potable water. For potable water service, select a coating material listed in the NSF 61 Standard.
1. Prime Coat and Finish Coats (3 or more):
 - a) DFT = 16-19 mils (400 to 475 microns).
 - b) Products: Ameron Amercoat 395, Carboline 891, Tnemec 139, Sherwin Williams Tank Clad H.S., or equal.
 2. For coating of valves and non-submerged equipment, DFT = 12-14 mils (300-350 microns).
- C. System 101 – Polyamide Cured Epoxy: Use a high-build, polyamide epoxy resin with a solids content of at least 56 percent by volume. Use a coating suitable for long-term immersion in potable water. For potable water service, select a coating material listed under NSF 61 Standard.
1. Prime Coat and Finish Coats (3 or more):
 - a) DFT = 12-14 mils (300-350 microns).
 - b) Products: Tnemec 20, VyGuard 78PR, Sherwin Williams Macropoxy 646 NSF, or equal.
- D. System 102 – Coal Tar Epoxy: Use a high-build, 2-component amine or polyamide-cured coal tar epoxy with a solids content of at least 68 percent by volume. Use a coating suitable for long-term immersion in wastewater or for coating of buried surfaces. Coating must conform to Mil Spec DOD-P-23236, or to SSPC Paint 16. Prime coats are for use as a shop primer only. Omit prime coat when both surface preparation and coating are performed in the field.

1. Prime Coat: DFT = 1.5-2.5 mils (38-65 microns).
 - a) Products: Ameron Amercoat 83HS, Tnemec P66, VyGuard V75, Sherwin Williams Copoxy Primer, or equal.
 2. Finish Coats (2 or more):
 - a) DFT = 14-18 mils (350-450 microns).
 - b) Products: Ameron 78HB, Carbomastic 14, Tnemec 46H413, VyGuard 64, Sherwin Williams Targuard Coal Tar Epoxy, or equal.
 - c) Total System DFT = 15.5-20.5 mils (387-513 microns).
- E. System 103 – Fusion Bonded Epoxy: Use a 100 percent powder epoxy applied in accordance with ANSI/AWWA C213, except prepare surface as specified in the coating system schedule in this Section. Apply the coating using the fluidized bed process.
1. Liquid Epoxy: For field repairs, use a 100 percent solids liquid epoxy as recommended by the powder epoxy manufacturer to provide a DFT of 15-17 mils (375-425 microns).
 2. Powder Coating:
 - a) DFT = 15-17 mils (375-425 microns).
 - b) Products: Scotchkote 134 or 206N, Napgard 7-0008 or 7-2500, or equal.
 - c) Total System DFT = 15-17 mils (375-425 microns).
 - d) For coating of valves, DFT = 11-12 mils (275-300 microns).
- F. System 104 – Chemical Resistant Sheet Lining:
1. Materials: Use natural rubber, chlorobutyl rubber, ethylene propylene diene monomer (EPDM) rubber, chloroprene polymer (neoprene) rubber, or chlorosulfonated polyethylene (Hypalon) rubber sheet lining material. Submit shop drawings containing technical information that confirms the suitability of the lining material system for long-term immersion in each chemical to be stored. Service temperatures are expected to be up to 150° F (65° C).
 - a) Neoprene Sheet Lining Material: Use a synthetic rubber formulated for steam curing at atmospheric pressure. Provide a minimum lining thickness of 3/16 inch. Supply B.F. Goodrich compound 59688, or equal.
 - b) Chlorobutyl Sheet Lining Material: Use a synthetic rubber formulated for steam curing at atmospheric pressure. Supply B.F. Goodrich compound 60924, or equal.
 - c) Natural Rubber (soft) Sheet Lining Material: Use a soft natural rubber formulated for steam curing at atmospheric pressure. Provide a minimum lining thickness of 3/16 inch. Supply B.F. Goodrich compound 83160, or equal.
 - d) Natural Rubber (hard) Sheet Lining Material: Use a hard, natural rubber resistant to oxidizing agents and formulated for autoclave curing. Provide a minimum lining thickness of 3/16 inch. Supply B.F. Goodrich compound 8631, or equal.
 - e) EPDM Sheet Lining Material: Use synthetic rubber suitable for use as a lining for 50 percent sulphuric acid solution and formulated for autoclave or steam curing under pressure.

- f) Hypalon Sheet Lining Material: Use synthetic rubber suitable for use as a lining for 50 percent sulfuric acid solution.
 - 2. Primers: Use primers, adhesives, activators, accelerators, and other necessary materials as recommended by the sheet material manufacturer.
 - 3. Metal Surface Preparation: Prior to abrasive blast cleaning, prepare the base metal as required by the sheet lining material manufacturer's installation instructions. If the instructions differ from these specifications, provide the highest degree of cleaning and surface preparation required by either instructions or specifications. Perform abrasive blast cleaning in accordance with this section.
 - 4. Installation: Install lining materials in accordance with the material manufacturer's written installation instructions. Line interior surfaces including piping, vents, fittings, flange faces, manhole covers, and blind flanges.
 - 5. Testing: Test the lining system for holidays in accordance with this Section before and after curing.
 - 6. Curing: Cure the lining system by steam using the time and temperature as required by the material manufacturer.
- G. System 105 – Vinyl Ester: Use vinyl ester resin coating material with an inert flake pigment that is suitable for immersion service in 30 percent hydrochloric acid and 30 percent sulfuric acid solutions.
- 1. Coating (2 or more coats):
 - a) DFT = 40-45 mils (1000-1125 microns).
 - b) Products: Plasite 4100, Sherwin Williams Magnalux 304 FF, or equal.
 - c) Prime Coat: As recommended by the material manufacturer.
- H. System 106 – 100% Solids Epoxy: Use a solventless epoxy resin coating suitable for severe service areas subject to splash, spillage or intermittent immersion in wide range of industrial chemicals and wastewater. Coating to resist normal abrasion from rolling vehicles.
- 1. Coating (2 or more coats):
 - a) DFT = 15-20 mils (325-500 microns).
 - b) Products: Ameron, Carbolite, Sherwin CorCote HCR.
 - c) Prime Coat: As recommended by manufacturer.
- I. System 107 – 100% solids Epoxy Sealer: Use a clear, unpigmented solventless epoxy suitable for application over marginal surfaces, including damp surfaces, tight rust and tight old coatings. Coating serves as primer for alkyd, acrylic, epoxy, and polyurethane finish coats.
- 1. Coating (1 coat only):
 - a) DFT = 1-2 mils (25-50 microns).

- b) Products: ICI/Devoe 167 PrePrime, Carboline Rust Bond, Sherwin Williams 920 PrePrime, or equal.
- J. System 108 - 100% Solids, Isocyanate-Free, Solvent-Free, High Build Epoxy Coating for Wastewater applications only, to be spray applied in one or more coats to all interior surfaces of exposed concrete above the spring line or as otherwise detailed.
- 1. Product Characteristics:
 - a. Product: 100% solids, solvent-free high-build epoxy system
 - b. Product Type: amine cured epoxy
 - c. VOC Content (ASTM D3960): 0%
 - d. Compressive Strength, psi (ASTM D695): 10,500 (minimum)
 - e. Tensile Strength, psi (ASTM D638): 4,500 (minimum)
 - f. Flexural Strength, psi (ASTM D790): 7,500 (minimum)
 - g. Adhesion to Concrete, psi/mode of failure (ASTM D7234): 350 psi (minimum)/with substrate (concrete) failure
 - h. Chemical Resistance, pH $\geq$ 0.5 (ASTM G20): 60% Sulfuric Acid
 - 2. In all cases the coating product(s) shall be applied to a minimum dry film thickness of 80 mils to surface profiles of CSP-4 to CSP-5 or 125 mils minimum DFT to surface profiles of CSP-6 or greater.
 - 3. When the wall of the liner is to be structurally designed to withstand the hydraulic load generated by the groundwater table the long term (50yr) value of the flexural modulus of elasticity will be utilized to calculate the thickness of the structural line. The initial flexural modulus of elasticity (short term) of the submitted resin material will be utilized with the long term deformation percentage as determined by ASTM D2990 in the design equation outlined in ASTM 1216-09, Appendix XI. The value of the long term flexural modulus of the proposed product will be certified by an independent, certified, third party testing lab, independent of the Manufacturer. [The definition of long term value will be identified as initial flexural modulus of elasticity less the reduction in value caused by Creep over a fifty (50) year minimum period and verified by third party testing (ASTM D2990).]
 - 4. Subsequent top-coating or additional coats of the coating product(s) shall occur within the product recoat window or 24 hours whichever is less. Additional surface preparation procedures will be required if this recoat window is exceeded.

- K. System 109 - 100% Solids, Solvent-Free, Multi-Layered Polymer Lining System (Polyurea and Polyurethane) for Wastewater applications only, to be spray applied in three layers to all interior surfaces of exposed concrete above the spring line or as otherwise detailed.
1. Product Characteristics:
 - a. Product: 100% solids, solvent-free, polyuria (two layers) and polyurethane (one layer) system
 - b. Product Type: Self-curing polymer lining
 - c. VOC Content (ASTM D3960): 0%
 - d. Tensile Strength, psi (ASTM D412): 2,400 (minimum)
 - e. . Elongation % (ASTM D412): 200 (minimum)
 - f. Tear Strength, pli (ASTM D624): 300 (minimum)
 - g. Shore D Hardness, (ASTM 2240): 45 (minimum)
 - h. Adhesion to Concrete, psi/mode of failure (ASTM D7234): 350 psi (minimum)/with substrate (concrete) failure
 - i. Chemical Resistance, pH $\geq$ 0.5 (ASTM G20): 30% Sulfuric Acid
 2. In all cases the coating product(s) shall be applied to a minimum thickness of 500 mils total.
 3. For resistance to ground water head pressure the coating shall be a minimum of 500 mils thick for depths up to 32 feet. For depths greater than 32 feet consult the coating manufacturer for recommendations.
 4. Subsequent top-coating or additional coats of the coating product(s) shall occur within the product recoat window or 24 hours whichever is less. Additional surface preparation procedures will be required if this recoat window is exceeded.
- L. System 110 – 100% Solids, High Build Polyurethane Coating for Wastewater applications, to be spray applied in one or more coats to all interior surfaces of exposed concrete above the spring line or as otherwise detailed.
1. Product Characteristics:
 - a. Product: 100% solids, high-build polyurethane system
 - b. Product Type: Catalyzed, two component, polyurethane
 - c. VOC Content (ASTM D3960): 0%

- d. Compressive Strength, psi (ASTM D695): 18,000 (minimum)
 - e. Tensile Strength, psi (ASTM D638): 7,450 (minimum)
 - f. Flexural Strength, psi (ASTM D790): 14,000 (minimum)
 - g. Flexural Modulus, psi (ASTM D790): 735,000 (minimum)
 - i. Adhesion to Concrete, psi/mode of failure (ASTM D7234): 200 psi (minimum) with substrate (concrete) failure
 - j. Chemical Resistance, pH 0.5 (ASTM G20): 20% Sulfuric Acid
- 2. In all cases the coating product(s) shall be applied to a minimum dry film thickness of 80 mils to surface profiles of CSP-4 to CSP-5 or 125 mils minimum DFT or surface profiles of CSP-6 or greater.
 - 3. When the wall of the resin based liner is to be structurally designed to withstand the hydraulic load generated by the groundwater table the long term (50yr) value of the flexural modulus of elasticity will be utilized to calculate the thickness of the structural line. The initial flexural modulus of elasticity (short term) of the submitted resin material will be utilized with the long term deformation percentage as determined by ASTM D2990 in the design equation outlined in ASTM 1216-09, Appendix XI. The value of the long term flexural modulus of the proposed product will be certified by an independent, certified, third party testing lab, independent of the Manufacturer. [The definition of long term value will be identified as initial flexural modulus of elasticity less the reduction in value caused by *Creep over a fifty (50) year minimum period and verified by third party testing (ASTM D2990).*]
 - 4. Polyurethane product characteristics allow high build thicknesses to be achieved in one application without additional surface preparation. However, if installation requires applications outside of the recoat window, additional surface preparation may be necessary by using a primer or abrading the previously coating surface area.

PART 3 EXECUTION

3.01 MANUFACTURER'S SERVICES

- A. Require the protective coating manufacturer to furnish a qualified technical representative to visit the project site for technical support as may be necessary to resolve field problems attributable to or associated with manufacturer's products.
- B. For submerged and severe service coating systems, require the paint manufacturer to furnish the following services:

1. Provide at least 6 hours of on-site instruction on the proper surface preparation, use, mixing, application, and curing of the coating systems.
2. Observe the start of surface preparation, mixing, and application and curing of the coating systems.
3. Provide the services of a NACE Certified Coating Inspector at all times during the surface preparation, mixing, application, curing and testing of all coatings applied in submerged or acid spill areas.

3.02 WORKMANSHIP

- A. Use skilled craftsmen and experienced supervision. For all jobs involving lead based paint removal or repair, require the presence of a certified Competent Person, Lead per OSHA requirements.
- B. Apply coating to produce an even film of uniform thickness. Give special attention to edges, corners, crevices, and joints. Ensure thorough cleaning and an adequate thickness of coating material. Apply coatings to produce finished surfaces free from runs, drips, ridges, waves, laps, brush marks, and variations in color, texture and finish. Effect complete hiding so that the addition of another coat would not increase the hiding. Give special attention to ensure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas. Apply a brushed stripe coat to all edges and welds after priming submerged or severe service areas.
- C. Remove, mask or otherwise protect hardware, lighting fixtures, switch plates, machined surfaces, couplings, shafts, bearings, name plates on machinery, and other surfaces not to be painted. Provide drop cloths to prevent coating materials from falling on or marring adjacent surfaces. Protect the working parts of mechanical and electrical equipment from damage during surface preparation and coating operations. Mask openings in motors to prevent entry of coating or other materials.
- D. Do not damage adjacent work during blast cleaning operations. Perform spray painting under carefully controlled conditions. Promptly repair any damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.
- E. Coordinate cleaning and coating so that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.

3.03 SURFACE PREPARATION STANDARDS

- A. The following referenced surface preparation standards of the Society for Protective Coatings (SSPC) form a part of this Specification:
 1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from steel surfaces by cleaning with solvent, vapor degreasing, emulsion or alkaline cleaners, or steam.

2. Hand Tool Cleaning (SSPC-SP2): Removal of all loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter by hand chipping, scraping, sanding, and wire brushing.
3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by rotary or impact power tools, power wire brushing, or power abrading.
4. White Metal Blast Cleaning (SSPC-SP5/NACE 1): Removal of all visible oil, grease, soil, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter by blast cleaning.
5. Commercial Blast Cleaning (SSPC-SP6/NACE 3): Removal of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter, except limit random staining to no more than 33 percent of each unit area of surface.
6. Brush-Off Blast Cleaning (SSPC-SP7/NACE 4): Removal of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose coating, all of which are considered tightly adherent if they cannot be removed by lifting with a dull putty knife.
7. Near-white Blast Cleaning (SSPC-SP10/NACE 2): Removal of all visible oil, grease, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter, except limit random staining to no more than 5 percent of each unit area of surface.

3.04 METAL SURFACE PREPARATION (UNGALVANIZED)

- A. Provide the minimum abrasive-blasted surface preparation as indicated in the coating system schedules at the end of this Section. Where there is a conflict between these specifications and the coatings manufacturer's printed recommendations for the intended service, the higher degree of cleaning applies.
- B. Perform metal surface preparation in conformance with the current SSPC/NACE Standards and this Section. Blast cleaned surfaces must match standard samples in SSPC-VIZ 1.
- C. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning using solveng cleaning as per SSPC-SP1.
- D. Round or chamfer sharp edges. Grind to smooth finish burrs, surface defects, and weld splatter prior to blast cleaning.
- E. Select the type and size of abrasive to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. As abrasives for submerged and severe service coating systems use clean, hard, sharp cutting crushed slag. Do not use automated blasting systems and metal shot or grit for surfaces that

- will be in submerged service, even if subsequent abrasive blasting is planned with hard, sharp-cutting slag.
- F. Do not reuse abrasive except when an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, use clean, oil-free abrasives. In the abrasive mix, use at least 50 percent steel grit. Replenish abrasive mix with new shot/grit combination as necessary to maintain the anchor profile within ½ mil (13 microns) of the specified profile.
 - G. Comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.
 - H. For air-blast cleaning, supply compressed air at adequate pressure from well-maintained compressors equipped with oil and a moisture separator which delivers oil and water-free air as checked with white blotter, white cloth, or plastic sheets at the beginning of each blasting sequence.
 - I. Clean surfaces of dust and residual particles of the cleaning operation using dry air-blast cleaning, vacuuming, or another approved method prior to painting. Vacuuming must be the final cleaning method immediately prior to painting areas that will go into submerged service.
 - J. In enclosed areas and other areas where dust may settle, vacuum the surface clean and wipe it with a tack cloth.
 - K. Remove damaged or defective coating by the specified blast or power tool cleaning to meet the clean surface requirements before recoating.
 - L. If the specified abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be in submerged service, then SSPC-SP2 – Hand Tool Cleaning or SSPC-SP3 – Power Tool Cleaning, may be used. If the coated area to be cleaned is less than 100 square feet, and will be in submerged service, then SSPC-SP11 Power Tool Cleaning to Bare Metal may be used.
 - M. Completely remove shop-applied coatings of unknown composition before the specified coatings are applied. Examine valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment for the presence of shop-applied temporary coatings. Completely remove temporary coatings by solvent cleaning per SSPC-SP1 method before starting abrasive blast cleaning. Alternate cleaning methods such as Baking Soda Blasting or Sponge Jet Blasting may be used as appropriate.
 - N. Use the solvent cleaning method (SSPC-SP1) to clean shop-primed equipment in the field before finish coats are applied.

3.05 SURFACE PREPARATION FOR GALVANIZED FERROUS METAL

- A. For galvanized ferrous metal, use the alkaline cleaning method per SSPC-SP1 to remove oil, grease, and other contaminants detrimental to adhesion of protective coatings. Alternate methods with biodegradable surfactant type cleaners followed by fresh water washing may be used as appropriate.
- B. Apply pretreatment coatings of surfaces in accordance with the printed recommendations of the coating manufacturer.

3.06 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS

- A. Remove grease, oil, heavy chalk, dirt, or other contaminants by solvent or detergent cleaning prior to abrasive blast cleaning. Determine the generic type of the existing coatings by laboratory testing.
- B. Provide the degree of cleaning specified in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, remove deteriorated coatings by abrasive blast cleaning to meet the requirements of SSPC-SP6 Commercial Blast Cleaning. Clean areas of tightly adhering coatings to meet the requirements of SSPC-SP7 Brush-Off Blast Cleaning, with the remaining thickness of pre-existing coating not to exceed 3 mils.
- C. If coatings to be applied are not compatible with existing coatings, apply intermediate coatings conforming to the paint manufacturer's recommendation for the indicated coating system or completely remove the existing coating prior to abrasive blast cleaning. Make a small trial application for compatibility prior to painting large areas. Allow the trial application to cure for 7 days at 50° F (10° C) or higher before determining compatibility.
- D. Completely remove coatings of unknown composition prior to application of new coatings.
- E. Where specified or where job site conditions do not permit dry-abrasive blasting for industrial coating systems due to dust or air pollution considerations, water jetting or wet-abrasive blasting may be used. In both methods, use inhibitors approved by the manufacturer of the coating system, which will be applied over the cleaned area. Begin the coating application as soon as the surface has dried, and before the formation of any flash rusting. Perform water jetting with or without abrasive injection, as appropriate, to achieve the specified degree of surface cleanliness. Do not use water-jetting methods for submerged or severe-service coating systems, unless specified for that area.

3.07 PLASTIC, FIBERGLASS, AND NONFERROUS METALS SURFACE PREPARATION

- A. Unless otherwise indicated, for equipment or parts of equipment which are not submerged in service, shop-prime, and then finish-coat in the field after installation. For methods, materials, application equipment, and other details of shop painting, comply with this

Section. If the shop primer requires topcoating within a specified period of time, apply the finish coating in the shop and then touch-up the paint after installation.

- B. Perform surface preparation and coating work in the field for equipment, or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves.
- C. For certain pieces of equipment, it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switch gear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the required quality in the field. For such equipment, prime and finish-coat in the shop and touch-up in the field after installation. Use the identical material for touch-up that was used for shop painting. Require the manufacturer of each such piece of equipment to certify as part of its shop drawings that the surface preparation is in accordance with these specifications. Submit the coating material product data sheet with the shop drawings for the equipment.
- D. For certain small pieces of equipment, the manufacturer will have a standard coating system, which is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the shop drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.
- E. Protect shop-painted surfaces during shipment and handling. Protect surfaces with padding or blocking. Lift equipment with canvas or nylon slings. Before being topcoated, do not expose primed surfaces to the weather for more than 2 months or less when recommended by the coating manufacturer.
- F. Repair damage to shop-applied coatings in accordance with this Section and the coating manufacturer's printed instructions.
- G. Make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Submit copies of applicable coating manufacturer's product data sheets with equipment shop drawings.

3.08 APPLICATION OF COATINGS

- A. Apply protective coatings to steel substrates in accordance with SSPC-PA1 – Paint Application Specification No. 1. Shop, Field and Maintenance Painting.
- B. Inspect cleaned surfaces and each coat prior to succeeding coats. Schedule inspections with the City Engineer in advance.
- C. Paint blast-cleaned ferrous metal surfaces before rusting or other deterioration of the surface occurs. Limit blast cleaning to only those surfaces that can be coated in the same working day unless the area to be coated is protected by humidity control equipment set to maintain humidity below 50 percent at all times.

- D. Apply coatings in accordance with the manufacturer's instructions and this Section, whichever has the most stringent requirements.
- E. Give special attention to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thickness is likely to occur. Use stripe painting by brush, after application of the primer, for these areas.
- F. Give special attention to materials, which will be joined so closely that proper surface preparation and application are not possible. Coat such contact surface prior to assembly or installation. Use only inorganic zinc primers on faying surfaces.
- G. Apply finish coats, including touch-up and damage repair coats, in a manner which will present uniform texture and color-matched appearance.
- H. Do not apply coatings under the following conditions:
 - 1. Temperature outside of the manufacturer's recommended minimum and maximum range.
 - 2. Dust or smoke laden atmosphere.
 - 3. Substrate or air temperature less than 5° F (3° C) above the dew point.
 - 4. Air temperature is expected to drop below 40°F (14° C) or less than 5° F (3° C) above the dew point within 8 hours after application of the coating.
 - 5. Wind conditions in excess of 15 MPH or dust laden.
- I. Determine the dew point by use of a sling psychrometer in conjunction with the U.S. Department of Commerce, Weather Bureau psychrometric tables.
- J. For steel piping which will not be buried, have the surface abrasive blast cleaned and primed before installation.
- K. Apply finish coats after concrete, masonry, and equipment installation is complete and the work areas are clean and dust free. Concrete must have cured for a minimum of 28 days @ 75° F (24° C) unless an approved epoxy sealer has been applied to green concrete within 12 hours of finishing the concrete.

3.09 CURING OF COATINGS

- A. Maintain curing conditions in accordance with the recommendations of the coating material manufacturer and this Section, whichever is the most stringent. Complete curing before placing the coating systems into service.
- B. In the case of enclosed areas, forced air ventilation using heated air may be required until the coatings have fully cured.
- C. Forced air ventilation is required for the application and curing of coatings on the interior surfaces of enclosed hydraulic structures. During application and curing periods, continuously exhaust air from the lowest level of the structure using portable ducting to force air into all compartments and around baffles. After interior coating operations have been

completed, provide a final curing period that meets the minimum temperature and time requirements of the manufacturer of the coating system being applied, while operating the forced air ventilation system continuously.

3.10 SHOP AND FIELD INSPECTION AND TESTING

- A. Give the City Engineer a minimum of 3 days advance notice of the start of any field surface preparation work or coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.
- B. Perform surface preparation and coating applications in the presence of the City Engineer, or his appointed NACE certified coating inspector, unless the City Engineer has granted prior approval to perform the work in their absence.
- C. Inspection by the City Engineer or the NACE certified inspector, or the waiver of inspection of any particular portion of the work, does not relieve the Contractor of his responsibility to perform the Work in accordance with these Specifications.
- D. Erect and move scaffolding where requested by the City Engineer to facilitate inspection. Provide additional illumination to light areas to be inspected. Remove or grind smooth all scaffolding clips welded to the structure prior to surface preparation of the structure.
- E. Until final acceptance of the coatings, furnish inspection devices in good working condition for the detection of holidays and measurement of dry-film thickness (DFT) of protective coatings. Make DFT gauges available for the City Engineer's use throughout the coating process until final acceptance of the coatings. Provide the services of a NACE certified coating inspector for all holiday detection work until the final acceptance of the coatings. Operate holiday inspection devices in the presence of the City Engineer.
- F. Perform holiday tests on coated ferrous surfaces inside a steel reservoir, other surfaces that will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Perform holiday tests on surfaces coated with any of the submerged and severe service coating systems. Mark and repair or recoat areas which contain holidays in accordance with the coating manufacturer's printed instructions and then retest. **DO NOT PERFORM HOLIDAY TESTING AFTER STRUCTURE HAS BEEN SUBMERGED.**
 - 1. Coatings with Thickness Exceeding 20 mils (500 microns): For surfaces having a total DFT exceeding 20 mils (500 microns); use a pulse-type holiday Detector such as Elcometer 136, or equal. Adjust and operate in accordance with NACE RP0188.
 - 2. Coatings with Thickness of 20 mils (500 microns) or Less: For surfaces having a total DFT of 20 mils or less, use Elcometer 269 non-destructive type holiday detector, or equal. Instrument must operate at less than 75 volts. For thicknesses between 10 and 20 mils (250 and 500 microns), a non-sudsing type wetting agent such as Kodak Photo-Flo, or equal, may be added to the water prior to wetting the detector sponge. For submerged or severe service areas, the residue of the wetting agent must be removed with clean, fresh water prior to application of any additional coats.

- G. On ferrous metals, measure the DFT in accordance with SSPC-PA2 Measurement of Dry Film Thickness with magnetic gauges using either a pull-off type gauge (Elcometer 211) or constant pressure gauge (Elcometer 345F), or equal. Test each coat for the correct thickness. Calibrate the DFT gauge at the beginning of each workday or shift in accordance with the directions of the manufacturer of the gauge. Do not take measurements until at least 8 hours after coating application. On non-ferrous metals, measure the DFT with positive pressure eddy current gages (Elcometer 345N) or equal.
- H. Evaluation of blast-cleaned surface preparation work will be based upon comparison with photographic samples contained in SSPC-VIZ 1.
- I. Evaluation of surface profile will be based upon the use of TesTex pressure sensitive tapes.

3.11 PAINTING AND IDENTIFICATION OF PIPING

A. Painting and Color Coding:

- 1. Use colors and signs to identify all piping which is exposed to view in buildings or tunnels, above suspended ceilings or exposed above grade, and all outdoor piping. Identify each pipe by a color complying with the following schedule of colors and by applied markers.
- 2. Coat pipes with the number of coats and type of material specified. Base coats for pipeline painting may be a neutral color. Make each succeeding base coat a contrasting color. For the final coat, comply with the pipe identifying color schedule.
- 3. Apply pipe identification markers to exposed piping, except for the following pipe at wastewater lift stations:
 - a) Discharge piping for wastewater pumps.
 - b) Vent piping.
 - c) Any piping inside wet wells.

B. Pipe Identification Markers:

- 1. Identify all pipes with applied signs or markers at 15-foot centers, at both sides of penetrated walls or floors, adjacent to valves, at connected equipment, at branch fittings, and in congested pipe layouts.
 - a) Apply markers consisting of signs with legends as follows:

OUTSIDE DIAMETER OF PIPE OR COVERING (INCHES)	LENGTH OF COLOR FIELD (INCHES)	SIZE OF LETTERS (INCHES)
3/4 to 1- 1/4	8	1/2
1- 1/2 to 2- 3/8	8	3/4
2- 1/2 to 5- 7/8	12	1- 1/4
6 to 7- 7/8	12	1- 1/4
8 to 10	24	2- 1/2
Over 10	32	3- 1/2

- b) As pipe markers, use semi-rigid outdoor grade acrylic plastic, Seton Name Plate Corp., SetMark, or equal. Use Type SNA for outside diameters 3/4 through 5- 7/8 inches and Type STR for 6-inch outside diameter or larger. For pipes less than 3/4-inch in diameter, use applied marker of brass identification tags 1-1/2 inches square with depressed letters 1/4-inch high, black-filled. Apply tightly to pipeline with metal or plastic straps.

C. Pipe Identification Color Schedule:

1. For wastewater facilities refer to current version of TCEQ chapter 217. For piping systems not found in TCEQ chapter 217, use the colors listed in the following pipe identification color schedule for facilities:

PIPE IDENTIFICATION COLOR SCHEDULE

PIPING SYSTEM	COLOR	FED. STD. NO.
Fire Mains	Red	11105
Oxygen	Orange	12246
Sodium Hypochlorite	Yellow	13655
Raw Polymer	Pink	11156
Diluted Polymer	Purple	17142
Natural Gas	Yellow	13655
Heating Water	Pink	11158
Domestic Hot	Light Pink	11668
Potable Water	Blue	15102
Non-Potable Water	White	17875
Instrument Air	Green	14187
Plant Air	Dark Green	14110
Raw Sewage	Gray	16473
Grit	Dark Gray	16187
Cyclone Return	Gray	16473
Classifier Return	Gray	16473
PIPING SYSTEM	COLOR	FED. STD. NO.
Heavy Solids	Dark Brown	10080
Return Sludge	Brown	10091
Waste Sludge	Yellow-Brown	10266
Scum	Light Brown	10334
Chilled Water Supply (CWS)	Blue-Green	14329
Chilled Water Return (CWR)	Blue-Green	14325
Condensing Water Supply (Cond-WS)	Light Green	14533
Condensing Water Return (Cond-WR)	Light Green	14533
Deionized Water (DW)	Light Blue	15526
Vacuum (Vac)	White	17875
Vent	Light Gray	16492

2. For pipe identification colors not listed above, follow American National Standard (ANSI A13.1-81) Color Schedule:

- a) Materials inherently hazardous, flammable or explosive; chemically active or toxic; extreme temperature or pressure; radioactive: Yellow Field with Black Letters.
- b) Material of inherently low hazard – liquid or liquid admixture: Green Field with White Letters; gas or gaseous admixture: Blue Field with White Letters.
- c) Fire quenching materials, water, foam, carbon dioxide, Halon, etc.: Red Field with White Letters.

3.12 COATING SYSTEM SCHEDULES – FERROUS METALS

A. Coating System Schedule, Ferrous Metal – Not Galvanized

SCHEDULE NO. AND APPLICATION	SURFACE PREPARATION	SYSTEM NO./ DESCRIPTION
FM-1: Surfaces indoors and outdoors, exposed or covered, except those listed below.	Near White Metal blast cleaning SSPC-SP10/NACE 2	(2) Inorganic zinc/epoxy/polyurethane
FM-2: Surfaces in chlorination room, chlorine storage room, sodium hypochlorite storage room	Near White Metal blast cleaning SSPC-SP10/NACE 2	(100) Amine-cured epoxy
FM-3: Surfaces of pumps and equipment and other ferrous surfaces submerged or intermittently submerged in potable water, utility water, and wastewater; including surfaces lower than 2 feet above high-water level in hydraulic structures, and surfaces inside enclosed hydraulic structures, pump state wet wells, and vents (excluding shop-coated valves, couplings, and pumps).	White Metal Blast Cleaning SSPC-SP5/NACE 1	(100) Amine-cured epoxy
FM-4: Surfaces exposed to high temperature between 150 ⁰ and 600 ⁰ F (65 ⁰ and 315 ⁰ C).	Near White Metal blast cleaning SSPC-SP10/NACE 2	(3) Inorganic Zinc, water-based
FM-5: Surfaces exposed to high temperature between 600 ⁰ and 1000 ⁰ F.	Near White Metal blast cleaning SSPC-SP10/NACE 2	(9) Aluminum silicon resin
FM-6: Where indicated, ferrous surfaces in water passages of valves 4-inch size and larger, exterior surfaces of submerged valves.	White Metal Blast Cleaning SSPC-SP5/NACE 1	(101) Polyamide-cured epoxy
FM-7: Where indicated, ferrous surfaces in water passages of pumps which have discharge size of 4 inches or larger; exterior, submerged surfaces of pumps.	White Metal Blast Cleaning SSPC-SP5/NACE 1	(101) Polyamide-cured epoxy
FM-8: Ferrous surfaces of sleeve couplings.	White Metal Blast Cleaning SSPC-SP5/NACE 1	(103) Fusion-bonded epoxy
FM-9: Ferrous surfaces of sluice gates, flap gates, and shear gates, including wall thimbles.	White Metal Blast Cleaning SSPC-SP5/NACE 1	(101) Polyamide-cured epoxy
FM-10: Structural steel, miscellaneous metal work, and supports for prefabricated metal	Commercial Blast Cleaning (SSPC-	(10) Zinc Rich Epoxy

Lift Station Mitigation Package 4
City of Friendswood

PROTECTIVE COATINGS

buildings, not exposed to view in finished building.	SP6/NACE 3	
FM-12: Ferrous metal exposed to view, inside and outside of buildings.	Near White Metal blast cleaning SSPC-SP10/NACE 2	(2) Inorganic zinc/epoxy/polyurethane
FM-13: Surfaces of indoor equipment not submerged.	Commercial Blast Cleaning SSPC-SP6/NACE 3	(5) Epoxy, equipment
FM-14: Exterior (exposed) surfaces shop-coated with fusion-bonded epoxy.	Light abrasive blast to roughen surface	(6) Aliphatic polyurethane

- B. Coating System Schedule, Ferrous Metal – Galvanized: Apply pretreatment coatings, barrier coatings, or washes as recommended by the coating manufacturer.

SCHEDULE NO. AND APPLICATION	SURFACE PREPARATION	SYSTEM NO./ DESCRIPTION
FMG-1: Exposed surfaces indoors and outdoors, except those listed below.	Alkaline cleaning SSPC-SP1	(1) or (4) Aliphatic Polyurethane, or Acrylic
FMG-2: Surfaces in chlorination room, chlorine storage room, and sodium hypochlorite storage room.	Alkaline Cleaning SSPC-SP1	(100) Amine-cured epoxy
FMG-3: Surfaces submerged in water or wastewater, including surfaces lower than 2 feet above high-water level and surfaces inside hydraulic structures and vents	Alkaline cleaning SSPC-SP1 followed by Brush-Off blast cleaning SSPC-SP7/NACE 4	(100) Amine-cured epoxy
FMG-4: Surface exposed to view, inside and outside of building.	Alkaline Cleaning SSPC-SP1	(1) or (4) Aliphatic polyurethane, or Acrylic

- C. Coating System Schedule, Interior Surface of Welded Steel Tanks: Coat interior surfaces, including tank nozzles, manholes, nozzle necks, and flange faces. For steel tank exterior coating systems, see paragraph 3.15.1, Coating System Schedule, Ferrous Metal – Not Galvanized.

PRODUCT STORED	SURFACE PREPARATION	SYSTEM NO. /DESCRIPTION
Zinc Orthophosphate	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (soft) or neoprene
Liquid Alum	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (soft) or neoprene
Polymer	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (soft) or neoprene
Sodium Bisulfite	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (soft) or neoprene
Ferric Chloride	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (hard)
Aqueous Ammonia	White metal blast cleaning SSPC-SP5/NACE1	(104) Chlorobutyl rubber
Caustic Soda	Commercial Blast Cleaning	No Coating

	SSPC-SP6/NACE 3	
Sodium Hypochlorite	White metal blast cleaning SSPC-SP5/NACE1	(104) Chlorobutyl Rubber
Sulfuric Acid (max. 45% concentration)	White metal blast cleaning SSPC-SP5/NACE1	(107) Hypalon
Sulfuric Acid (above 40% concentration)	White metal blast cleaning SSPC-SP5/NACE1	(107) Viton
Hydrofluosilicic Acid	White metal blast cleaning SSPC-SP5/NACE1	(107) Chlorobutyl Rubber
Water, Potable Water, Utility Water	White metal blast cleaning SSPC-SP5/NACE1	(100) Amine-Cured Epoxy

3.13 COATING SYSTEM SCHEDULES, NONFERROUS METAL, PLASTIC, FIBERGLASS

Where isolated non-ferrous parts are associated with equipment or piping, use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames, or hatches. Use primers recommended by coating manufacturer.

SCHEDULE NO. AND APPLICATIONS	SURFACE PREPARATION	SYSTEM NO./ DESCRIPTION
NFM-1: Exposed surfaces, indoors and outdoors, except those listed below.	Solvent cleaned SSPC-SP1	(1) Aliphatic Polyurethane
NFM-2: Chlorination room, chlorine storage room, sodium hypochlorite storage room.	Solvent cleaned SSPC-SP1	(100) Amine-Cured Epoxy
NFM-3: Aluminum surfaces in contact with concrete, or with any other metal except galvanized ferrous metal.	Solvent cleaned SSPC-SP1	(8) Aluminum Metal Isolation
NFM-4: Polyvinyl chloride plastic, indoors and outdoors, not submerged.	Solvent cleaned SSPC-SP1	(4) Acrylic
NFM-5: Fiberglass surfaces.	Per paragraph 3.09, Plastic, Fiberglass, and Non-Ferrous Metals Surface Preparation	(6) Aliphatic Polyurethane Fiberglass

END OF SECTION

SECTION 13300

PROCESS CONTROL SYSTEMS – GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. A Process Control System Integrator (PCSS) shall furnish all services and equipment defined herein and in other specification sections as listed in Paragraph 1.03, Related Work.
- B. All materials, equipment, labor, and services required to achieve a fully configured integrated and operational process control system shall be provided. The PCSS shall design and coordinate the process control system for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications and with related existing equipment.
- C. Owner pre-selected Application Engineering System Supplier (AESE or SE) will provide all software programming of SCADA/HMI based on the Owner's defined standards. PCSS will provide the lift station control panel and the SCADA communication panel. PCSS shall program and configure the Level controller.
- D. Programming, configuration, and integration, including but not limited to Ethernet configuration and communications between all field I/O and PLC communications shall also be provided by the SE. In addition, the SE shall be responsible for providing all third-party software/PLC code required to establish communication with the supplied hardware. SE is also responsible for any necessary coordination and additions to the Owner's existing SCADA system for remote monitoring and controlling of the system supplied under this project based on the Owner's operation needs. It shall be understood that when the PCSS is directed in this specification to provide any of the services reserved in this paragraph for the SE, the SE and not the PCSS shall provide those services.
- E. All configuration, and integration, including but not limited to: loading of all software on computers, network equipment configuration, Ethernet configuration, and communications between servers and RTUs shall be provided by the SE. All programming of RTUs and HMI shall be by the SE. The AESE shall furnish the operating system software and the application software.
- F. Auxiliary and accessory devices necessary for system operation or performance to interface with existing equipment or equipment provided by other suppliers under other sections of these specifications, shall be included whether or not they are shown on the drawings. These devices include, but are not limited to, transducers, current isolators, signal conditioners, interposing relays, power supplies, and fiber optic transceivers.
- G. Substitution of functions or type of equipment specified shall not be acceptable. In order to ensure parts are interchangeable, maintain quality, interface between the various subsystems, and establish minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained. System design

shall allow for the removal of individual devices from service without disrupting other devices in service.

- H. Equipment shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations by the equipment manufacturer as approved by the Engineer.
- I. The PCSS shall be responsible for calibrating all existing instruments that will interface with the new control system.
- J. To facilitate the Owner's future operation and maintenance, products shall be by the same major manufacturer, with panel-mounted devices of the same type and model as far as possible.
- K. The lift station is an existing plant, and all work shall be coordinated with its operating personnel to minimize impact on daily operations. Specifically, the contractor shall be responsible for providing a detailed daily plan to demonstrate how each of the systems shall be replaced or modified so that there is no operational downtime experienced by the plant. This plan shall be submitted for review and approval before any work is started on site. The actual sequence of the work is left to the contractor, but extensive pre-planning is necessary to accomplish the work.
- L. The lift station is a fully operational facility monitored and controlled by local panels and Level Controller. After the switchover, the PCSS and AESS both must demonstrate that all new equipment and reused existing equipment are connected to their supplied equipment and are fully functional as specified and shown on the Contract Drawings.
- M. The Owner shall retain salvage rights to all material and equipment removed in the course of this work. All materials and equipment retained by the Owner shall be delivered to a point designated by the Owner in Friendswood, Texas. Any material or equivalent not retained by the Owner shall be removed from the site and disposed of by the General Contractor in accordance with applicable regulations and laws.
- N. All equipment and installations shall satisfy applicable Federal, State, and local codes.
- O. The Contract Drawings and related specification sections provide additional details showing building plan layouts, instrument device specifications, functional requirements of the system, and interfacing with other equipment.
- P. All materials, equipment, labor, and services necessary to achieve the monitoring and control functions described herein shall be provided in a timely manner so that the monitoring and control functions are available when the equipment is ready to be placed into service.
- Q. The PCSS shall coordinate and schedule all required testing with the General Contractor, Owner, and Engineer.
- R. The PCSS shall coordinate and schedule all required training with the General Contractor, Owner, and Engineer.

- S. The PCSS shall provide a monthly status report and updated project schedule to the General Contractor to be included in the General Contractor's overall project schedule.
- T. The PCSS shall provide control panels for all areas shown on the contract drawings and specified herein. The electrical contractor shall furnish all wiring between the instruments, PLC cabinet, and control panels. The PCSS shall coordinate the termination of all wires in the control panels and PLC cabinet.

1.02 MEASUREMENT AND PAYMENT

- A. No separate payment will be provided for work performed under this Section. Include the cost for this work in the lump sum base bid.

1.03 RELATED WORK

- A. The PCSS shall furnish all materials, labor, and services specified in the following specification sections as required ensuring that a single, coordinated system is supplied:
 - 1. Section 13302 – Process Control Systems Testing
 - 2. Section 13303 – Process Control Systems Training
 - 3. Section 13330 – Control Panel Enclosures and Panel Mounted Equipment
 - 4. Section 13335 – Control Panel UPS (Single Phase)
 - 5. Section 13340 – Process Control Instruments
 - 6. Section 13400 – Control Loop Descriptions
 - 7. Section 16195 – Electrical Identification
- B. Divisions requiring coordination shall include, but not be limited to, the following:
 - 1. Division 1 - General Requirements
 - 2. Division 11 – Equipment
 - 3. Division 13 - Special Construction
 - 4. Division 15 - Mechanical
 - 5. Division 16 - Electrical
- C. The PCSS shall coordinate with all equipment suppliers, mechanical subcontractor, electrical subcontractor, and General Contractor.

1.04 COORDINATION MEETINGS

- A. The PCSS shall schedule and administer a minimum of three mandatory coordination meetings. The PCSS shall make arrangements for meetings; and prepare an agenda with copies to participants at least one week before scheduled meetings. The meetings will be conducted at the Owner's designated location and shall include, as a minimum, attendance by the Owner, Engineer, General Contractor's project engineer, PCSS's project engineer, AESS and the electrical subcontractor.

1. The first coordination meeting shall be held in advance of the first PCSS shop drawing submittal. The purpose of the first meeting shall be for the PCSS to:
 - a. Summarize their understanding of the project
 - b. Discuss any proposed substitutions or alternatives
 - c. Schedule testing and delivery milestone dates
 - d. Provide a forum for the PCSS to coordinate hardware and software-related issues
 - e. Request any additional information required from the Owner and/or Engineer.
 - f. The PCSS shall bring a draft version of shop drawings to the meeting to provide the basis for the Owner/Engineer's input into their development.
2. The second coordination meeting shall be held after the Field Instruments, Digital System Hardware, and Control Panels and Panel Mounted Equipment shop drawing submittals have been reviewed by the Engineer and returned to the PCSS. The purpose of the second meeting is to:
 - a. Discuss comments made on the submittal packages
 - b. Refine scheduled milestone dates
 - c. Coordinate equipment installation activities
3. The last coordination meeting shall be held one month prior to factory acceptance testing. The purpose of the last coordination meeting is to discuss any remaining coordination requirements.
4. A typical agenda may include, but is not limited to, the following:
 - a. Review minutes of previous meetings
 - b. Review of work progress
 - c. Field observations, problems, and decisions
 - d. Identification of problems, which impede planned progress
 - e. Review of submittal schedule and submittal status
 - f. Review of off-site fabrications and delivery schedules
 - g. Maintenance of progress schedule
 - h. Corrective measures to regain projected schedules
 - i. Planned activities for subsequent work period
 - j. Coordination of projected progress
 - k. Maintenance of quality and work standards
 - l. Effect of proposed changes on progress schedule and coordination
 - m. Other business relating to the project

- B. The costs associated with the coordination meetings, including auto expenses, meal expenses, etc., shall not be included as part of the work of this section.

1.05 SUBMITTALS

A. General Requirements:

1. Refer to Section 01330 for general submittal requirements.
2. Shop drawings shall demonstrate that the equipment and services to be furnished comply with the provisions of these specifications and shall provide a complete record of the equipment as manufactured and delivered.
3. Submittals shall be bound in separate three ring binders, with an index and sectional dividers, with all drawings reduced to a maximum size of 11-inch by 17-inch, then folded to 8.5 inch by 11-inch for inclusion within the binder. Maximum binder size shall be 3-inches.
4. The submittal drawings' title block shall include, as a minimum, the PCSS's registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing.
5. Exceptions to the Specifications or Drawings shall be clearly defined by the PCSS in a separate section of each submittal package. The submittal shall contain the reason for exception, the exact nature of the exception and the proposed substitution so that the Engineer may make a proper evaluation. The acceptability of any device or methodology submitted as an "or equal" or "exception" to the specifications shall be at the sole discretion of the Engineer.
6. The PCSS shall submit all of the submittals in accordance with this Section. Incomplete or partial submittals not complying with the submittal arrangements outlined in this Section will be returned without review.
 - a. Separate submittals shall be made as follows:
 - i. Qualifications Submittal
 - ii. Project Plan and Schedule Submittal
 - iii. Coordination Meetings Agenda
 - iv. Hardware, Panel Drawing, Loop Drawing, and Software Submittal.
 - v. Spares and Expendables Submittal.
 - vi. Certification of Installation Submittal.
 - vii. Application Development Submittal.
 - viii. Final System Documentation
 - (1) Preliminary O&M Outline Plan Submittal
 - (2) Operations and Maintenance Manual Submittal
7. Qualifications Submittal:

- a. Submit, within 15 calendar days after Notice to Proceed, detailed information on staff and organization to show compliance with the Quality Assurance requirements of this Section. The Qualifications submittal shall be submitted and approved before any further submittals will be accepted. Failure to meet the minimum requirements shall be grounds for rejection as a PCSS. The Qualifications Submittal shall, as a minimum, contain the following:
 - i. Copies of ISA CCST Level 1 certificates for all field technicians or resumes demonstrating field experience.
 - ii. Notarized statement from the firm's financial institution demonstrating ability for the firm to meet the obligations necessary for the performance of the work.
 - iii. Copy of UL-698 certificate for panel fabrication facilities.
 - iv. Project references for water or wastewater projects as defined in the Quality Assurance paragraphs.
 - v. Documentation to demonstrate the ability to complete this project including: resumes of key staff, financial capacities, details on engineering, design, fabrication, and field service capacity, and location of staff responsible for responding to the site within four hours to resolve startup issues.
- 8. Project Plan, Deviation List, and Schedule Submittal:
 - a. Submit, within 45 calendar days after Notice to Proceed, a Project plan. The Project Plan shall be submitted and approved before further submittals shall be accepted. The Project Plan shall, at a minimum, contain the following:
 - i. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. A discussion of startup, replacement of existing equipment with new, switchover (Maintaining Plant Operations during system transition), approach to testing and training, and other tasks as required by these specifications shall be included as applicable.
 - ii. Preliminary software and hardware submittal information solely to determine compliance with the requirements of the Contract Documents prior to the PCSS development of process control programs and system layouts. Favorable review of software and hardware systems as part of this Project Plan stage shall not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein.
 - iii. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.
 - iv. Preliminary coordination meeting agendas as specified herein.

- v. Preliminary testing plan.
 - vi. Preliminary training plan.
 - vii. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, loop, and I/O wiring diagrams.
9. Exceptions to the Specifications or Drawings shall be clearly defined in a Deviation List. The Deviation List shall consist of a paragraph by paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that an evaluation may be made by the Engineer. If no exceptions are taken to the specifications or drawings the PCSS shall make a statement as such. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.
10. Project schedule shall be prepared in Gantt chart format clearly showing task linkages for all tasks and identifying critical path elements. PCSS schedule must be based on the General Contractor schedule and must meet all field installation, testing, and start-up milestones in that schedule. The project schedule shall illustrate I&C related major project milestones including the following:
- a. Schedule for all subsequent project submittals. Include the time required for Contractor submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
 - b. Proposed dates for all project coordination meetings.
 - c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
 - d. Shipment of instrument and control system equipment.
 - e. Installation of instrument and control system equipment.
 - f. Testing: Schedule for all testing.
 - g. Schedule for system cutover, startup, and/or going on-line for each major system.
 - h. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.
 - i. Incorporate time constraints for AESS activities.
11. Coordination Meetings Agenda: Agendas shall be submitted for the Coordination Meetings as specified herein. Submit the proposed Control System Coordination Meeting Agenda a minimum of two weeks prior to the scheduled meeting date for review and comment by the Engineer.
12. Input/Output (I/O) List Submittal:
- a. Submit, within 60 days after Notice to Proceed, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.

- b. I/O list shall be based on the P&ID's, the Drawings, the design I/O list (if included), and requirements in the Specifications.
- c. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.
- d. The I/O list shall reflect all active and spare I/O points. Add points to accommodate spare I/O as required in the specifications.
- e. The I/O list shall be arranged such that each control panel has a dedicated worksheet. At a minimum, I/O worksheet shall include the following information:
 - i. TAG NUMBER(S): As indicated on the Drawings, the identifier assigned to a device that performs a function in the control system. As part of this information, the loop number of the tag shall be broken out to allow for sorting by loop.
 - ii. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
 - iii. PHYSICAL LOCATION: The Control Panel designation of where the I/O point is wired to.
 - iv. Physical POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
 - v. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.
 - vi. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points are "1."
 - vii. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
 - viii. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
 - ix. P&ID - the P&ID or drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.
- f. The I/O list shall be sorted in order by:
 - i. Physical location.
 - ii. I/O Type.
 - iii. Loop Number.
 - iv. Device Tag.
- g. Once the I/O list is approved, the PLC I/O addresses shall not be modified without approval by the Engineer.

- h. For I/O layout requirements, see the PLC Section 13311.
- B. Field Instruments Submittal:
 - 1. Refer to the Instruments section for submittal requirements.
- C. Hardware and Software Packages Submittal:
 - 1. Refer to the sections below for specific Hardware and Software Packages submittal requirements:
 - a. 13330 - Control Panels and Panel Mounted Equipment.
 - 2. For each hardware and software packages component specified in the sections above, submit a cover page that lists, at a minimum, date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001 (updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
- D. Panel Layout Drawings and Wiring Diagrams Submittal:
 - 1. Refer to the Control Panels section for submittal requirements.
- E. Testing Plan Submittals:
 - 1. Refer to Section 13302 - Testing for specific testing submittal requirements.
- F. Training Plan Submittals:
 - 1. Refer to Section 13303 for specific training requirements.
- G. Spares and Expendables Lists Submittal:
 - 1. Submit a list of, and descriptive literature for, spares and expendables.
 - 2. Submit a list of, and descriptive literature for, additional spares and expendables recommended by the manufacturer.
 - 3. Submit unit and total costs for the additional spare items specified or recommended for each subsystem.
- H. Certification of Installation
 - 1. After completion of system installation, submit written certification on PCSS's letterhead that the system installation has been completed to the PCSS's satisfaction as specified.
- I. Operations and Maintenance (O&M) Manuals:
 - 1. Submit in accordance with Section 01782.
 - 2. Furnish O&M manuals as specified herein.
 - 3. The operations and maintenance manuals shall, at a minimum, contain the following information:
 - a. Table of Contents:

- i. A Table of Contents shall be provided for the entire manual with the specific contents of each volume clearly listed. The complete Table of Contents shall appear in each volume.
- b. Instrument and Equipment Lists:
 - i. The following lists shall be developed in Microsoft Excel format and provided not only as a hardcopy in O&M but also electronically on a CD.
 - ii. An instrument list for all devices supplied including tag number, description, specification section and paragraph number, manufacturer, model number, serial number, range, span, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
 - iii. An equipment list for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, serial number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
- c. Equipment Operations and Maintenance Information:
 - i. ISA-TR20.00.01-2001(updated in 2004-2006) data sheets shall be provided for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001(updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
 - ii. Vendor O&M documentation for each device, piece of equipment, or OEM software shall be either new documentation written specifically for this project, or modified standard vendor documentation. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or crossed out. Groups of pages that do not apply at all to the specific model supplied shall be removed.
 - iii. Provide the record documentation of the system audit as specified in Section 13302 - Testing.
 - iv. Include the calibration forms developed as specified in Section 13302 - Testing.
- d. As-Built Drawings:
 - i. Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. These drawings shall include all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS.

- ii. As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.
- e. Electronic O&M Information:
 - i. In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of configuration files, on CDROM or DVD. Electronic documents shall be supplied in Adobe Acrobat format.
 - ii. Provide electronic files for all custom-developed manuals including training manuals. Text shall be supplied in both Microsoft Office format and Adobe Acrobat format.
 - iii. Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
 - iv. Each computer system hardware device shall be backed up onto CDROM or DVD after Substantial Completion and shall be turned over to the Owner.
 - v. If specified in the training section, provide digital copies of all training videos. Videos shall be in a format that is readable by standard DVD players and by standard PC DVD drives. Format shall be a minimum of 800 by 600 pixels and shall include sound.
- f. The cover and edge of each volume shall contain the following information:
 - Project Name (refer to Contract Documents)
 - Contract Number (refer to Contract Documents)
 - Instrumentation and Control System
 - Hardware Operations and Maintenance Manual
 - Specification Sections _____, _____, _____
 - Subcontractor Name
 - Date
 - Volume X of Y

(Where X is the volume number and Y is the number of volumes)
- g. Retrofit Documentation - The PCSS shall investigate, diagnose, repair, update and distribute all pertaining documentation of deficiencies, which become evident during the warranty period. All such documentation shall be submitted to the Engineer within 30 days of solving the problem.

1.06 COORDINATION MEETINGS

- A. Schedule the mandatory coordination meetings as described herein. The meetings shall be held at the Owner's designated location and shall include attendance by the Owner, the Engineer, the Contractor, the PCSS's Project Engineer, and the AESS

Project Engineer, if applicable. Other Division 13 specifications may require additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. Meeting shall be scheduled a minimum of one week before the requested meeting date.

1. A project kickoff coordination meeting shall be held within two weeks after submitting the Project Plan. The purpose of the meeting shall be to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. The meeting will last up to one business day.
2. A submittal review coordination meeting shall be held after the Hardware, Panel Drawing, and Loop Drawing Submittal package has been reviewed by the Engineer and returned to the PCSS. The purpose of this meeting shall be to review comments made on the submittal package; to refine scheduled deadline dates; coordinate equipment installation activities; and provide a forum for any further required coordination between the PCSS and AECS. The meeting will last up to one business day.
3. Regular on-site meetings when the PCSS staff is at the plant site.

1.07 REFERENCE STANDARDS

- A. Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.
- B. International Society of Automation (ISA):
 1. ISA S5.2, Binary Logic Diagrams for Process Operations.
 2. ISA S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.
 3. ISA S5.4, Instrument Loop Diagrams.
 4. ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
 5. ISA RP60.3, Human Engineering for Control Centers.
 6. ISA RP60.6, Nameplates, Labels, and Tags for Control Centers.
 7. ISA-99, Industrial Automation and Control Systems Security.
- C. National Electrical Manufacturers Association (NEMA).
- D. National Fire Protection Agency (NFPA):
 1. NFPA 70, National Electrical Code (NEC).
 2. NFPA 79, Industrial Control Equipment.
- E. Underwriters Laboratories, Inc. (UL):

1. UL 698A - Industrial Control Equipment - for custom fabricated equipment.
2. A nationally recognized testing laboratory, as approved by the Authority having jurisdiction, may substitute for UL listing on commercial off the shelf products.

1.08 QUALITY ASSURANCE

- A. The Process Control System Supplier (PCSS) shall be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems integrator" shall be interpreted to mean an organization that complies with all of the following criteria:
1. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel shall hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel shall include, as a minimum, the lead field technician.
 2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be for projects where the PCSS's contract was of similar size to this project.
 3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.
 - a. The PCSS shall maintain a permanent, fully staffed and equipped service facility within 200 miles of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 4 hours of notification starting at two months before scheduled start up to two months after startup completion.
 - b. PCSS shall hold a valid UL-698A certification for their panel fabrication facility.
 - c. Actual installation of the instrumentation system need not be performed by the PCSS's employees; however, the PCSS as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.
 - d. The selected PCSS shall be one of the following:
 - i. Weimar Manufacturing
505 South Eagle St.
Weimar, TX 78962
Attn: Frank Macaulay

Phone 979-725-8527

ii. Prime Controls, LP

10400 Westoffice Drive, Suite 105

Houston, TX 77042

Attn: Weldon Mahan

Phone: 713-244-9747

iii. Boyer Inc.

8904 Fairbanks

N. Houston Road

Houston, TX 77064

Attn: Jacy Levy

Phone: 713-466-5395

- e. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section.
- f. Listed PCSS's will not be required to submit a qualification proposal. Suppliers interested in being listed, as an equal shall submit three (3) copies of a qualification proposal to the Engineer no later than two weeks before the bid opening date. A list of approved equals will be issued no later than four (4) days before the bid opening date.
 - i. The qualification proposal shall provide details and a description of how the supplier proposes to fulfill the requirements set forth in this Specification. The supplier shall present the proposal in sufficient detail so that proper evaluation regarding the experience and capabilities of the supplier can be performed.
 - ii. The proposal shall contain evidence that the supplier has sufficient financial resources to meet the obligations incidental to the performance of the work including available bonding. (This requirement may be provided in the form of a verifiable or certified financial report for the company's latest fiscal year).
 - iii. The proposal shall contain a list of personnel available for assignment to the responsible positions of Project Manager, Project Engineer, Lead Programmer, Installation Supervisor, and Area Service Representative. Also, include a concise resume of each individual's education, work experience, and accomplishments.
 - iv. The proposal shall contain the following specific information:
 - (1) Maintenance services available for hardware and software: Evaluation will be based on the supplier's capability to provide the required routine and emergency services. The supplier's proposal is to describe the capabilities and location of his/her nearest (to job site) service organization. It is the intent of the Specification to obtain all system maintenance services from the supplier. If the supplier intends to

subcontract all or portions of the service requirements, it must be stated as such along with the name and address of the organization.

- (2) Technical validation examples of recently completed and similar scope projects: The supplier shall provide information regarding type, size, complexity, and performance of five (5) systems recently completed, along with names, addresses, and telephone numbers of persons qualified to verify supplier's statements approximate cost of the instrumentation system supplied, project completion date and description. Evaluation shall be based on the similarity of system requirements and supplier's performance.
- (3) A description of how the supplier plans to execute the various functions and locations where the various portions of the work will be performed, coordinated, and managed (e.g., design, engineering, manufacturing, programming, testing, and scheduling). The vendor is required to state in his/her proposal those functions, which he/she intends to subcontract to other organizations and include the name, address, and capabilities of these organizations.
- v. The supplier shall be required to demonstrate a minimum of five (5) years of recent, past experience in the design, manufacture, and commissioning of instrumentation and control systems of comparable size, type, and complexity to the proposed project. The supplier shall be required to have his/her own in-house capability to handle complete system engineering, fabrication, and testing.
- vi. The supplier shall indicate that he/she has in his/her employ capable personnel for detailed engineering, coordination, drafting, procurement and expediting, scheduling, construction, testing, inspection, installation, training start-up service for calibration and commissioning, and warranty compliance for the period specified.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Provide Delivery, Storage, and Handling requirements per Division 01 and as specified below.
- B. Shipping Precautions
 - 1. After completion of shop assembly, factory test, and approval of all equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy-duty (5 mil) polyethylene envelopes or secured sheeting to provide protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing the protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.
 - 2. Manufacturer's special instructions for field handling, storage and installation required for protection, shall be securely attached to the packaging for each piece

of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other means of protection.

3. None of the HMI control and monitoring equipment shall be shipped to the site until the control room areas comply with specified ambient temperature and humidity. Have qualified personnel accept the equipment on delivery and supervise unloading within the control room areas.
4. If any apparatus has been damaged, such damage shall be repaired at no additional cost to the Owner.

1.10 NOMENCLATURE AND IDENTIFICATION

A. Field Instrument Tags

1. See P&ID.

B. Panel Nameplates:

1. See Section 13330.

1.11 WARRANTY

- A. Provide warranty Division 01, Warranties and Bonds, and as specified herein.**

1.12 O & M MANUALS

- A. Prior to final acceptance of the system and owner training, operating and maintenance manuals covering instruction and maintenance on each type of equipment shall be furnished in accordance with Section 01782, Operating and Maintenance Data.**

- B. The instructions shall be bound in three ring binders with Drawings reduced or folded for inclusion and shall provide the following as a minimum:**

1. A comprehensive index
2. A complete "As Constructed" set of approved shop Drawings
3. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data
4. Full specifications for each item
5. System schematic drawings "As Constructed," illustrating all components, piping and electrical connections of the systems supplied under this Section
6. Detailed service, maintenance, and operation instructions for each item supplied
7. Special maintenance requirements particular to this system clearly defined, along with special calibration and test procedures
8. Operating instructions which incorporate a functional description of the entire system, with references to the systems schematic Drawings and instructions
9. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier
 - a. The final documentation shall be new documentation written specifically for this project, but may include standard and modified standard documentation.

Modifications to existing hardware or software manuals shall be made on the respective pages or inserted adjacently to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.

- b. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.
- c. If the PCSS transmits any documentation or other technical information, which he considers proprietary, such information shall be designated. Documentation or technical information which is designated as being proprietary will be used only for the design, construction, operation, or maintenance of the system and, to the extent permitted by law, will not be published or otherwise disclosed.
- d. The final documentation requirements are as follows:
 - i. As-built documentation shall include all previous submittals, as described in this Specification, updated to reflect the as built system. Any errors in or modifications to the System resulting from the Factory and/or Field Acceptance Tests shall be incorporated in this documentation.
 - ii. The Hardware Maintenance documentation shall describe the detailed preventive and corrective procedures required to keep the System in good operating condition. Within the complete Hardware Maintenance documentation, all hardware maintenance manuals shall make reference to appropriate diagnostics, where applicable, and all necessary timing diagrams shall be included. A maintenance manual or a set of manuals shall be furnished for all delivered hardware, including peripherals. The Hardware Maintenance documentation shall include, as a minimum, the following information:
 - (1) Operation Information - This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
 - (2) Preventive Maintenance Instructions - These instructions shall include all applicable visual examinations, hardware testing, diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the System.
 - (3) Corrective Maintenance Instructions - These instructions shall include guides for locating malfunctions down to the card replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.

- (4) Parts Information - This information shall include the identification of each replaceable or field repairable module. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross references between the Instrumentation System Supplier's part number and manufacturer's part numbers shall be provided.
- (5) System Backup/Restore - This information shall include a detailed description of the procedure for backing up the computer system (including PC and PLC); reloading using a backup; and completely restoring a PC and/or PLC from a backup.

1.13 MAINTENANCE CONTRACT

- A. A written proposal for a maintenance contract executed by the PCSS shall be provided to the Owner for on-site preventive maintenance services related to the Instrumentation and Control system. The cost of this maintenance contract shall not be included in the Contract Price.
- B. This proposal shall be provided within 30 days after final acceptance for the purpose of entering a contract for annual maintenance subsequent to the first year of maintenance. Standard per diem rates for providing breakdown service shall be set forth in the contract. Such rates shall be fair and reasonable and reflect the lowest rates offered to most favored customers. The fee quoted shall be firm for a minimum of 90 days from date of issue.
- C. This maintenance contract shall include all labor, parts, and emergency calls providing on-site response within 24 hours, to provide complete system maintenance for a period of one year after the date of Substantial Completion of the system for all equipment and software provided as part of the PCSS scope of work.
- D. Provide software updates throughout the maintenance contract period. Provide latest official released version for all software provided under this Contract. Owner shall have the latest software releases at the end of the maintenance contract period.
- E. The maintenance contract shall also include a minimum of 4 preventive maintenance visits by qualified service personnel of the Supplier who is familiar with the type of equipment provided for this project. Each preventive maintenance visit shall include routine adjustment, calibration, cleaning and lubrication of system equipment and verification of correct operation.
- F. Visits to the sites to correct deficiencies under warranty shall not be included in this preventive maintenance service contract.
- G. Emergency maintenance procedures or plant visits may coincide with a preventive maintenance visit, however, they shall not replace the work intended to be performed during a preventive maintenance visit. The Supplier shall have full responsibility for the system hardware preventive and corrective maintenance.
- H. During the one-year maintenance period, observation of maintenance operations by plant personnel and the instruction of said personnel in the details of the maintenance work being performed, shall be provided.

1.14 PROJECT/SITE REQUIREMENTS

- A. Environmental Requirements. Air-conditioned areas require NEMA Type 12 ventilated enclosures. Equipment below grade shall be NEMA Type 4X. All other areas require NEMA Type 4X stainless steel enclosures. Refer to Division 16 for area environmental hazardous classifications. All instrumentation enclosures and all instruments mounted outdoors shall be furnished with sun shields.
- B. Elevation. Equipment shall be designed to operate at a ground elevation of approximately 1500 feet above mean sea level.
- C. Temperature. Indoor areas' equipment shall be suitable for 10 to 35 C degrees ambient. Outdoor areas' equipment shall be suitable for 30 to 50 C degrees ambient. Storage temperatures shall range from zero to 50 C degrees ambient. Additional cooling or heating shall be furnished if required by the equipment.
- D. Relative Humidity. Air-conditioned area equipment shall be suitable for 20 to 95 percent relative, non-condensing humidity. All other equipment shall be suitable for 0 to 100 percent relative, condensing humidity.
- E. Power Supply. 120 volts AC sources of electric supply shall be unregulated industrial panel boards.

PART 2 PRODUCTS

2.01 GENERAL

- A. All instrumentation and electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture, and fungus. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.
- B. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks unless otherwise noted. Fasteners for securing control panels and enclosures to walls and floors shall be either hot-dipped galvanized after fabrication or stainless steel. Provide stainless steel fasteners only in corrosive areas rated NEMA 4X on the Drawings or as defined under Division 16. Provide minimum size anchor of 3/8-inch.
- C. All indicators shall be linear in process units, unless otherwise noted. All transmitters shall be provided with indicators in process units, accurate to two percent or better.
- D. All equipment, cabinets and devices furnished shall be heavy-duty type, designed for continuous industrial service. The system shall contain similar products of a single manufacturer, and shall consist of equipment models, which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.
- E. All electronic/digital equipment shall be provided with radio frequency interference protection.
- F. Electrical:

1. Equipment shall operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
2. With the exception for field device network connected devices, all electronic instrumentation shall utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).
3. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed.
4. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless noted otherwise.
5. Switches and/or signals indicating an alarm, failure or upset condition shall be wired in a fail-safe manner. A fail-safe condition is an open circuit when in an alarm state.
6. Materials and equipment shall be UL approved whenever such approved equipment and materials are available.
7. All equipment furnished shall be designed and constructed so that in the event of power interruption, the systems specified herein shall go through an orderly shutdown with no loss of memory, and shall resume normal operation without manual resetting when power is restored, unless otherwise noted.

2.02 ELECTRICAL SURGE PROTECTION

- A. General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an 8x20 μ s impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground.
- B. Provide protection of all analog signal (4-20 mA) circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Protection devices located near the transmitter shall be mounted in a separate NEMA 4X stainless steel enclosure (plastic is not acceptable) or conduit mounted, and shall be Phoenix Contact PT Series, MTL Surge Technologies (Telematic) TP48, Citel TSP-10 series, or equal. Substitution of a single device to protect both 120 VAC and 4-20 mA wires to an instrument is acceptable. Protection devices in control panels shall be MTL Surge Technologies (Telematic) SD Series, Phoenix Contact PT Series, Citel DLA series, or equal.

- C. Provide protection of all 120 VAC power feeds into control panels, instruments, and control room equipment. Surge arresters shall be Transtector ACP-100BW Series, Phoenix Contact "Mains-PlugTrab", MCG Surge Protection 400 Series, Citel DS40 series, or equal.
- D. Non-Fiber Based Data Highway or Communications Circuits - Provide protection on all communication and data highway circuits that leave a building or are routed external to a building. Circuit protection shall be provided at both ends of the line. Surge protection devices shall be Phoenix Contact PlugTrab Series, Transtector FSP Series, MTL Surge Technologies (Telematic) NP Series, Citel DLA series or MJ8 series, or equal.
- E. Inductive Loads - Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120 VA or less that drive solenoid, coil, or motor loads.
- F. Telephone Circuits - At a minimum, provide Telephone Company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract.

2.03 SPARE PARTS

- A. All spare parts shall be wrapped in bubble wrap, sealed in a polyethylene bag complete with dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's contact information (address and phone number), part name, part number, part ordering information, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the Owner or Engineer.
- B. Furnish one of each type of installed Surge protection devices.
- C. Other spare parts are specified in each section. An overview follows:
 - 1. Devices within Control Panels - See the control panels section.
 - 2. Instrument related Spare Parts - see the Instrument section.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

- A. Instrumentation and accessory equipment shall be installed in accordance with manufacturer instructions. The indicated locations of equipment, transmitters, alarms, and similar devices indicated are approximate only. Exact locations of all devices shall be as approved by the Engineer during construction. Obtain in the field, all information relevant to the placing of process control equipment and in case of interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner at no additional cost to the Owner.
- B. Provide brackets and hangers required for mounting of equipment.

- C. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at only one ground point for each shield.
- D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, ship material in sections sized to permit passing through restricted areas in the building. Provide on-site service to oversee the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. Certify that field wiring associated with the equipment is installed in accordance with best industry practice. Coordinate work under this Section with that of the electrical work specified under applicable sections of Division 16.
- E. Provide sunshades for equipment mounted outdoors in direct sunlight. Sunshades shall include standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North or as required to minimize the impact of glare and ultraviolet exposure on digital readouts.

3.02 TESTING

- A. Refer to Section 13302.

3.03 TRAINING

- A. Refer to Section 13303.

END OF SECTION

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SECTION 13302

PROCESS CONTROL SYSTEM TESTING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to complete the testing of all devices and systems furnished and installed as detailed on Drawings, and as specified herein.
- B. Refer to Section 13300 for other general requirements.

1.02 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED WORK

- A. Refer to Section 13300.
- B. Division 1 "Equipment Testing and Start-up" Section.

1.04 SUBMITTALS

- A. Refer to Section 13300.
- B. Testing Submittals - Submit, in one submittal, the following testing related documents:
 - 1. Status signoff forms:
 - a. Develop and submit project specific I/O Status and Automatic Control Strategy signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.
 - i. Example forms are shown in the Appendices.
 - ii. Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
 - iii. Submit testing forms prior to start of testing.
 - 2. Testing Procedures:
 - a. Submit detailed procedures proposed to be followed for each of the tests specified herein. The test procedures shall serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified.
 - b. Documents shall be structured in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.
 - c. Test procedures shall indicate all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.

- d. Test procedures shall be structured in a cause and effect manner where the inputs are indicated, and the outputs are recorded.
- e. Test procedures shall include the demonstration and validation under normal operating conditions and under various failure scenarios as specified in Contract Documents.
- f. Testing may not start until all Testing Submittals have been approved.

C. Test Documentation:

- 1. Upon completion of each required test, document the test by submitting a copy of the signed off Testing Status forms. Testing shall not be considered complete until the signed-off forms have been submitted and approved. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.05 MAINTENANCE

- A. Refer to Section 13300.

1.06 COST OF TRAVEL

- A. Scheduled tests will only be attended once by Engineer /Owner. If test is not successful, all subsequent tests will be performed at Contractor's expense. Reimburse Owner for all costs, including labor and expenses, invoiced by Engineer and incurred by Owner for subsequent retests.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 TESTING - GENERAL

- A. Refer to Section 13300.
- B. Results of all testing shall be tracked on a project specific status sign off form or similar document. PCSS shall be responsible for maintaining the sheet. Appendix of this Section has an example template for this sheet.
- C. As a minimum, the testing shall include the following:
 - 1. Factory Testing:
 - a. Unwitnessed Factory Test (UFT).
 - 2. Field Testing:
 - a. Operational Readiness Test (ORT)
 - b. Functional Demonstration Test (FDT).
 - c. Startup Acceptance Test (SAT).
- D. Each test shall be in the cause-and-effect format. The person conducting the test shall initiate an input (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement shall be satisfied.

- E. All tests shall be conducted in accordance with prior Engineer approved procedures, forms, and checklists. Each specific test shall be described and followed by a section for sign off by the appropriate party after its satisfactory completion.
- F. Copies of these sign off test procedures, forms, and checklists will constitute the required test documentation.
- G. Provide all special testing materials and equipment. Whenever possible, perform tests using actual process variables, equipment, and data. Suitable means of simulation shall be provided when it is not practical to test with real process variables, equipment, and data. Define these simulation techniques in the test procedures.
- H. The General Contractor shall require the PCSS to coordinate all testing with the Engineer, all affected Subcontractors, and the Owner.
- I. The Engineer/Owner reserves the right to test or retest all specified functions whether or not explicitly stated in the prior approved Test Procedures.
- J. The Engineer/Owner's decision shall be final regarding the acceptability and completeness of all testing.
- K. No equipment shall be shipped until the Engineer has received all test results and approved the system.
- L. The PCSS shall furnish servicemen and all special calibration and test equipment to perform the field tests.
- M. Correction of Deficiencies
 - 1. All deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet specification requirements at no additional cost to the Owner.
 - 2. Testing, as specified herein, shall be repeated after correction of deficiencies is made until the specified requirements are met. This work shall be performed at no additional cost to the Owner.

3.02 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)

- A. Purpose of UFT is for PCSS to check the system. This type of testing should be part of any quality firm's internal QA/QC procedures.
- B. Hardware to be tested shall include all control system devices shown on System Architecture drawings and provided by PCSS and vendors.
- C. Tests to be performed shall include, but not be limited to, the following. Each of these tests shall be specifically addressed in Test Procedure submittal.
 - 1. All panels and enclosures being provided shall undergo a thorough inspection to verify integrity of cabinet enclosures, frame structures, paint work and finish, etc. Review panel drawings to ensure they accurately reflect panel layout and wiring.
 - 2. Panel wire pull tests shall be performed to ensure all wiring has been connected with appropriate torque to prevent wires from coming loose.

3. All control strategies shall be verified using simulation or other means to verify logic performs as expected. Verify faults and logical failure conditions for control strategies such as instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out of range testing (over and under scale) for analog inputs, and all other strategies specified in control strategy document.
 4. For each hardware enclosure, inspection shall include, but not be limited to, cabinet enclosures, frame structure, paint work and finish, dimensions, and hardware operability (i.e., fans, door hinges, keylocks, etc.).
 5. For each subpanel, inspection shall include, but not be limited to, power supply sizing and mounting, cable routing, wire runs across hinges properly installed, fans and blowers unobstructed and mounted to maximize air flow, power conditioning correctly installed, and overall layout and installation of components meets manufacturer's recommendations and standard industry accepted practices.
 6. All other control panel circuitry.
- D. Upon successful completion of UFT, PCSS shall submit a record copy of test results as specified in PART 1.

3.03 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

- A. Purpose of ORT is to check that process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test will determine if equipment is ready for operation.
- B. This test shall take place prior to FDT and startup. Prior to starting this test, relevant process equipment shall be installed and mechanically tested, instruments installed, control panels installed, and field wiring complete.
- C. Required Documents for Test:
 1. Master copy of the PCSS developed field testing signoff forms.
 2. Testing procedures.
 3. Calibration forms.
- D. These inspections, calibrations, and tests do not require witnessing. However, Engineer may review and spot-check testing process periodically. Any deficiencies found shall be corrected by PCSS prior to commencement of Functional Demonstration Test.
- E. PCSS shall maintain Sign-off forms and Calibration forms at job site and make them available to Engineer/Owner at any time.
- F. Following tests shall be performed as part of ORT:
 1. Instrument calibration, configuration, and set-up.
 2. Input/Output (I/O) Testing to SCADA HMI
 3. Testing of control strategies.

G. Instrument calibration, configuration, and set-up:

1. Calibrate, configure, and set-up all components and instruments to perform specified functions.
2. Calibration form:
 - a. For any component or instrument requiring dip switch settings, calibration, or custom configuration, maintain a calibration form in field documenting this information. These forms shall provide a summary of the actual settings used in the field to allow an Instrument technician to replace the device entirely and configure it to function as it did before.
 - b. This information shall be added to Instrument data sheet, shall be added to a copy of manufacturer's standard "Configuration Sheet", or a separate form shall be created.
 - i. If a separate form, the form shall list Project Name, Loop Number, ISA Tag Number, I/O Module Address, Manufacturer, Model Number/Serial Number, Output Range and Calibrated Value.
 - c. Some examples of required information are:
 - i. For Discrete Devices: Actual trip points and reset points.
 - ii. For Instruments: Any configuration or calibration settings entered into instrument
 - iii. For Controllers: Mode settings (PID).
 - iv. For I/O Modules: Dip switch settings, module configuration (if not documented in native programming documentation).
 - d. Maintain a copy of these forms in field during testing, and make them available for inspection at any time.
 - e. For any device that allows a software back-up of configuration files to a laptop, make configuration files available to Engineer/Owner for inspection. Submit as part of Final System Documentation as specified in Section 13300.

H. I/O Testing:

1. Purpose of I/O testing is to check that process equipment, instrument installation, calibration, configuration, field wiring, and control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.
2. PCSS in conjunction with Contractor and AESS shall test signals under process conditions. Preferred test method will always be to execute test wherever possible to end elements. For example, preferred test will prove valve open/close limit switches by operating valve, not by installing a jumper on limit switch contacts. However if equipment or process is not available to test a signal over its entire calibrated range, PCSS may test using a simulation methods and make a note on sign-off form.

3. The following I/O tests shall be performed:
 - a. Discrete Input: At device or instrument, change signal condition from inactive to active state. Observe results on all indicators within loop such as HMI screens, OIT screens, pilot lights, horns, beacons, etc.
 - b. Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing range. Observe results on all indicators within loop such as HMI screens, OIT screens, recorders, digital indicators, etc.
 - c. Discrete output signals shall be tested by switching equipment to manual control at the HMI and OIT nodes and turning output on or using other means to turn output on. Then verify equipment responds accordingly.
 - d. Analog output signals shall be tested by switching equipment to manual control at HMI and OIT nodes and turning output on or other means to turn output on. Then verify equipment responds accordingly.
 - I. Testing of Automatic Control Strategies:
 1. All automatic control strategies shall be verified using actual process equipment and instruments, or other means, to verify logic performs as expected. Verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, out of range testing for analog inputs, loss of power, and all other strategies specified in control strategy document.
 - J. Repeat all systems tests specified under factory testing.
 - K. UPS shall be tested to verify UPS switch power correctly while keeping all UPS powered loads online. Also, test sizing of UPS by switching off line power to UPS and verify if they maintain specified run time.
 - L. For all panels with enclosures modified by this Contract, internal control panel temperature shall be tested under full running conditions to ensure proper cooling/ventilation is being provided.
 - M. Upon successful completion of ORT, PCSS shall submit a record copy of test results as specified in PART 1 and request scheduling of FDT.
- 3.04 FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)
- A. After facility is started-up and running treatment process in automatic control to extent possible, a Functional Demonstration Test shall be performed. Purpose of FDT is to allow Engineer or Owner representatives to witness actual functionality, performance, and stability of system while connected to process equipment.
 - B. Required Documents for Test:
 1. Set of panel drawings and wiring diagrams from ORT with corrections noted
 2. Set of Contract Documents - all drawings and specifications.
 3. All design change related documentation.
 4. Signed-off master copy of the PCSS developed field testing signoff forms.
 5. Testing procedures.

6. Copy of completed calibration forms.
7. One copy of all O & M Manuals for PCSS supplied equipment.
- C. A witnessed FDT shall be performed on each process area. To extent possible, repeat testing performed during ORT.
- D. Daily schedule specified to be followed during factory tests shall also be followed during FDT.
- E. After coordinating with Operations, a "Black Start" of the plant shall be performed to confirm plant operation recovers as specified in Contract Documents. Black start means shutting off power to the plant and turning it back on. Separate tests shall be performed by recovering the plant while on generator (if a generator is specified) and while on utility power.
- F. Punch list items and resolutions noted during test shall be documented on Punch list/Resolution form. In event of rejection of any part or function test procedure, PCSS shall perform repairs, replacement, and/or retest within 10 days.
- G. Upon successful completion of the FDT, PCSS shall submit a record copy of test results as specified in "Part 1 - General".

3.05 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

- A. After completion of FDT, and system is started-up and running treatment process in automatic control to extent possible, system shall undergo a test as defined in Division 01 "Equipment Testing and Start-up" Section.
- B. While this test is proceeding, Engineer and Owner shall have full use of system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. Plant operations shall remain responsibility of Owner and decision of plant operators regarding plant operations shall be final.
- C. During this test, PCSS personnel shall be present as required to address any potential issues that would impact system operation. PCSS is expected to provide personnel for this test who have an intimate knowledge of hardware and software of system. When PCSS personnel are not on-site, PCSS shall provide cell phone/pager numbers that Owner personnel can use to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.
- D. Any malfunction during test shall be analyzed and corrections made by PCSS. In event of rejection of any part or function, PCSS shall perform repairs or replacement within 5 days.
- E. Throughout duration of SAT, no software or hardware modifications shall be made to system without prior approval from Owner or Engineer.

3.06 CERTIFICATE OF INSTALLATION

- A. Following successful completion of SAT test, PCSS shall submit a Certification of Installation for system as required in Division 1 "Equipment Testing and Start-up" Section.

END OF SECTION

APPENDIX 13302-A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM

An example template for I/O Status signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

APPENDIX 13302-B: EXAMPLE AUTOMATIC CONTROL STRATEGIES SIGN OFF FORM

An example template for Automatic Control Strategies signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific Automatic Control Strategies signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

[Project Name] Appendix A - Input/Output (I/O) Status Sign-Off Form

4-Jun-14

[Project name] Appendix A - Instrumentation (PC) Status: In Progress												
All Sections below are required to be filled out by PCSS as part of Field Testing.												
Instrument Alarm Setpoint - Setpoint for any alarms set by PCSS												
Wiring Complete - Signal wired from field device to PLC												
I/O Tested - Signal tested from field device to SPADA HMI												
PLC	Signal Tag	Description	Range or Active State when closed	P&ID	Signal	Rack	Slot	Channel	Instru- ment Alarm Setpoint	Calibrate, config, and Wiring complete	PCSS I/O testing	Notes
PLC-SC	LIT-4000-1	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1	0				
PLC-SC	LIT-4010-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1	1				
PLC-SC	SI-4100-1	RAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	2				
PLC-SC	SI-4100-4	RAS Pump No. 4 Speed Feedback	0-100%	15	AI	2	1	3				
PLC-SC	FI-4102-1	RAS Flow Pump 1-3	0-1500 GPM	14	AI	2	1	4				
PLC-SC	SI-4110-1	WAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	5				
PLC-SC	N/A	Spare Slot	N/A		Spare	2	5	N/A				
PLC-SC	SC-4100-1	RAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	0				
PLC-SC	SC-4100-2	RAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7	1				
PLC-SC	SC-4100-3	RAS Pump No. 3 Speed Setpoint	0-100%	14	AO	2	7	2				
PLC-SC	SC-4110-1	WAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	3				
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	4				
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	5				
PLC-SC	TSH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	0				
PLC-SC	XA-4000-1	Secondary Clarifier No. 1 Motor Overload	Normal	8	DI	3	1	1				
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	2				
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	3				
PLC-SC	YRI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1	4				
PLC-SC	YCI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1	5				
PLC-SC	YFI-4100-1	RAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	6				
PLC-SC	FAL-4100-1	RAS Pump No. 1 Low Flow	Normal	14	DI	3	1	7				
PLC-SC	Spare	Spare	Normal	14	DI	3	1	8				
PLC-SC	YRI-4100-1	RAS Pump No. 1 Running	Running	14	DI	3	1	9				
PLC-SC	YCI-4100-1	RAS Pump No. 1 In Remote	In Remote	14	DI	3	1	10				
PLC-SC	YFI-4110-1	WAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	11				
PLC-SC	FAL-4110-1	WAS Pump No. 1 Low Flow	Normal	14	DI	3	1	12				
PLC-SC	Spare	Spare	Normal	14	DI	3	1	13				
PLC-SC	YRI-4110-1	WAS Pump No. 1 Running	Running	14	DI	3	1	14				
PLC-SC	YCI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	15				
PLC-SC	HSS-4000-2	Secondary Clarifier No. 2 Start Command	Start	8	DO	4	6	0				
PLC-SC	Spare	Spare	N/A		DO	4	6	1				
PLC-SC	HSS-4100-2	RAS Pump No. 2 Start Command	Start	14	DO	4	6	2				
PLC-SC	HSS-7000-2	Sludge Holding Tank Tank Blower No. 2 Start Command	Start	17	DO	4	6	3				
PLC-SC	HSS-4100-5	RAS Pump No. 5 Start Command	Start	15	DO	4	6	4				
PLC-SC	Spare	Spare	N/A		DO	4	6	5				
PLC-SC	HSS-4105-1	Secondary Sludge Pump No. 2 Start/Stop	Start	15	DO	4	6	6				
PLC-SC	HSS-4110-2	WAS Pump No. 2 Start/Stop Command	Start	15	DO	4	6	7				
PLC-SC	7160-F01	Sludge Loadout LCP Pumping Indicator	Pumping	17	DO	4	6	8				
PLC-SC	Spare	Spare	N/A		DO	4	6	9				
PLC-SC	HSS-7115-2	Sludge Holding Tank Mixer No. 2 Start	Start	17	DO	4	6	10				
PLC-SC	Spare	Spare	N/A		DO	4	6	11				
PLC-SC	HSS-7117-2	Sludge Holding Tank Discharge Valve No. 2 Open CMD	Open	17	DO	4	6	12				
PLC-SC	HSS-7117-2	Sludge Holding Tank Discharge Valve No. 2 Close CMD	Close	17	DO	4	6	13				
PLC-SC	HSS-7120-2	TS Transfer Pump No. 2 Start Command	Start	17	DO	4	6	14				
PLC-SC	Spare	Spare	N/A		DO	4	6	15				

4-Jun-14 [Project Name] Appendix B - Automatic Control Strategies Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Testing

Auto. Control Strategies. - Loop operational in Automatic as defined in Control Strategies

Control Strategies Loop #	Control Strategy Description	P&ID	Auto. Control Strategy	Date	Notes
LOOP 281 - 284	LOW FLOW PUMPS	8			
LOOP 290	LOW EQ CHANNEL FLOW NO. 4	8			
LOOP 300	MICROFILTRATION AIR SUPPLY LOW PRESSURE	10			
LOOP 351, 352	SITE LIFT STATION PUMP NO.1 AND NO. 2	12			
LOOP 355	SITE LIFT STATION HIGH AND LOW LEVEL CONTROL	12			
LOOP 371, 372	SLUDGE HOLDING TANK NO.1 AND NO. 2 LEVEL	14			
LOOP 381, 382	SLUDGE TRANSFER PUMPS	14			
LOOP 385	SLUDGE TRANSFER PUMPS REMOTE START/STOP COMMAND	14			
LOOP 700	EFFLUENT PUMPING STATION LEVEL	14			
LOOP 701, 702, 703	EFFLUENT PUMP NO. 1	14			
LOOP 840	POST AERATION CHANNEL AIR FLOW CONTROL	15			
LOOP 900	SLUDGE TRANSFER PUMPS DISCHARGE FLOW	8			
LOOP 971	CENTRIFUGE SLUDGE FEED PUMP NO.1	8			
LOOP 1001	CENTRIFUGE NO.1 SLUDGE FEED FLOW CONTROL	8			
LOOP 1411, 1412	SODIUM HYPOCHLORITE STORAGE TANKS LEVEL	8			
LOOP 1421, 1422	SODIUM HYPOCHLORITE PUMPS	8			
LOOP 1430	SODIUM HYPOCHLORITE STORAGE TANKS CONTAINMENT AREA HIGH LEVEL DETECTION	14			
LOOP 2051, 2052, 2053	DIESEL ENGINE GENERATOR STATUS	14			
LOOP 2055	TRANSFER SWITCH STATUS	14			
LOOP 2060	GENERATOR KILOWATTS MONITORING	14			
APPENDIX ONE	EQUIPMENT RESTART DURING A POWER LOSS WITH THE GENERATOR RUNNING	14			
APPENDIX TWO	EQUIPMENT RESTART WITH POWER RESTORED AFTER A POWER LOSS	14			
N/A	SELF-HEALING CAPABILITIES OF NETWORK	N/A			
N/A	REDUNDANT SCADA SERVER FAILOVER AND RECOVERY	N/A			

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SECTION 13303

PROCESS CONTROL SYSTEM TRAINING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish training as specified herein.
- B. This Section covers the training requirements for all devices and systems furnished and installed as detailed on the Drawings.
- C. Refer to Section 13300.

1.02 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED WORK

- A. Refer to Section 13300.

1.04 SUBMITTALS

- A. Refer to Section 13300 for general submittal requirements.
- B. Training Plan Submittal
 - 1. The training plan shall include:
 - a. Definitions, objectives, and target audience of each course.
 - b. Schedule of training courses including proposed dates, duration and locations of each class.
 - c. Complete copy of all proposed handouts and training materials. Training information shall be bound and logically arranged with all materials reduced to a maximum size of 11 inch by 17 inch, then folded to 8.5 inch by 11 inch for inclusion into the binder.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 GENERAL

- A. The cost of the training programs shall be included in the Contract price. The training and instruction shall be directly related to the system being supplied. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the system.
- B. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.

- C. All onsite instructors must be intimately familiar with the operation and control of the Owner's facilities.
- D. Provide detailed training manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project. The manuals shall be provided in hardcopy for each student. Provide electronic copy of each training manual in PDF format for Owner's future use.
- E. The trainer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, all training materials shall be delivered to the Owner.
- F. F. The Owner reserves the right to videotape all custom training sessions. All training tapes shall become the sole property of the Owner.
- G. Cost of Travel for off-site training
 - 1. The cost of Travel for off-site training shall be paid directly by the entity employing the staff doing the traveling.

3.02 TRAINING SUMMARY

- A. The following training courses listed in the summary table shall, as a minimum, be provided:

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Control System Overview Seminar	Covered in AESS scope of work			
Operator Control System Training	Covered in AESS scope of work			
Installed Control System and Instrumentation	16	4	1	Maintenance, Administrator

- B. Definitions of audience roles

- 1. Administrator – personnel responsible for maintaining the HMI/SCADA system.
- 2. Maintenance - personnel responsible for maintaining the field controller hardware and instrumentation system.
- 3. Operations - personnel responsible for daily plant operations.
- 4. Management - non-daily operations personnel

3.03 ONSITE TRAINING

- A. Training personnel shall be intimately familiar with the control system equipment, its manipulation, and configuration. Training personnel shall command knowledge of system debugging, program modification, troubleshooting, maintenance procedure,

system operation, and programming, and shall be capable of transferring this knowledge in an orderly fashion to technically oriented personnel.

B. Installed Control System Training

1. Provide training for the Owner's personnel in the functionality, maintenance, and troubleshooting of the installed Control System. The training shall be held before the Functional Demonstrator Test (FDT), but not more than two months before.
2. Training and instruction shall be specific to the system that is being supplied.
3. Training shall consist of classroom instructions and hands-on instruction utilizing the Owner's system.
4. Detailed training shall be provided on the actual configuration and implementation for this Contract. Training shall cover all aspects of the system that will allow the Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. The training shall cover the following subjects, as a minimum:
 - a. System overview.
 - b. System hardware components and specific equipment arrangements.
 - c. Periodic maintenance.
 - d. Troubleshooting and diagnosis.
 - e. Network configuration, communications, and operation.
 - f. TCP/IP addressing procedures for all Ethernet devices.

END OF SECTION

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SECTION 13306

APPLICATIONS ENGINEERING SERVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. If referred to anywhere else in the project manual, Application Engineering (AE) or Applications Engineering System Supplier (AESS) services are those services specified in this Section. AESS is pre-selected by the Owner and will have an allowance in the bid for their scope of work. PCSS and Contractor to coordinate with AESS as specified in Division 13.
- B. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system as specified herein. All equipment shall be controlled in full conformity with the contract drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment.
 - 1. Provide programming and configuration of all PLCs/OITs supplied on the project along with overall SCADA/HMI integration will be performed by the AESS.
 - 2. Provide configuration of the HMI/SCADA System to incorporate signals from the control panels.
 - 3. Provide configuration of any alarm dialer(s) provided.
 - 4. Provide for and test communications and functionality between all connected devices (such as PLCs/OITs) and the SCADA/HMI software packages, including devices supplied by others in order to provide a comprehensive working system of data collection, storage and reporting.
 - 5. The standards and conventions used for programming the new PLCs/OITs and SCADA/HMI shall follow the existing standards in order to maintain consistency.
- C. All work shall be coordinated with plant operating personnel to minimize impacts on daily operation. Delays caused for any reason shall be noted and formally submitted to the Engineer and the Owner in the form of a letter.
- D. AESS shall utilize their system integrator development license to program the PLCs/OITs. No PLC or OIT software licenses shall be purchased for this project, nor will any be provided by the Owner.
- E. The AESS shall utilize their system integrator development license to program SCADA/HMI system. No SCADA/HMI software licenses shall be purchased for this project. The Owner will provide the AESS with access to the existing overall SCADA system, allowing for necessary modifications and the integration of the lift station as described in the project scope.

1.02 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED WORK

- A. Refer to Section 13300 "I & C - General Provisions."

1.04 SUBMITTALS

- A. Provide all required submittals in accordance with Section 01300. The submittals listed below shall be provided as a minimum;

- 1. Controller Program

- B. Supplement to Project Plan Submittal

- 1. Supplement the "Project Plan, Deviation List, and Schedule" submittal in Section 13300 by adding the following items to the submittal requirements:

- a. List of all graphics intended to be created for this project.
 - b. List of all PLC programs that will be created or modified for this project.

- C. Supplement to Input/Output (I/O) List Submittal

- 1. Supplement the "Input/Output (I/O) List " submittal in Section 13300 by adding the following item to the submittal requirements:

- a. LOGICAL POINT ADDRESS: I/O address of each point.

- F. Controller Program Submittal

- 1. For each controller, submit the following using the controller manufacturer's built in printing functions. Electronic submission of Adobe Portable Document Format ("pdf") files in lieu of paper submittals is acceptable. Review will be for general program organization, level of documentation, and overall programming standards. The review will not attempt to confirm the logic works correctly for every loop.
 - a. PLC programs showing ladder logic, function block, high level language or other controller language used. Include individual rung, network, and/or command descriptions with abundant comments to clearly identify function and intent of each code segment. Each logic segment shall be clearly presented, the function of each timer described, the purpose of each subroutine call labeled and defined, etc. Program documentation shall be sufficiently clear to allow determination of compliance with the process control requirements included in the control descriptions and with the Drawings. The submittal shall demonstrate that all logic provided under this project follows the same structure and format and reflects a common programming approach.
 - b. Submit a memory usage report for the controller. This report shall indicate total memory capacity and unused memory capacity.

- c. Submit cross reference index of I/O allocation and controller memory address. Every physical I/O point as well calculated or virtual I/O required for the implementation of the process scheme shall be included.
 - 2. Submit details of control system communication. Submit a "memory map" or other means showing which signals are exchanged between PLCs. Also submit an SCADA/HMI tag database showing all signals exchanged between the PLCs and SCADA/HMI. Any specific communication block memory addresses shall be defined.
 - 3. Include a section with OIT/SCADA HMI screens created as part of this project.
- 1.05 MAINTENANCE
 - A. Refer to Section 13300.
- 1.06 WARRANTY
 - A. Refer to Section 13300 and supplement that with the requirements below.
 - B. All application work shall be warranted in accordance with Division 01.
 - C. Provide telephone technical support within 4 hours of warranty claim. If a failure cannot be resolved by telephone, provide onsite technical support within 24 hours of warranty claim.
- 1.07 COORDINATION MEETINGS AND WORKSHOPS
 - A. Refer to Section 13300. The meetings below are in addition to the meetings specified in that section.
 - B. Schedule and conduct a graphics review meeting. The purpose of this meeting is to finalize the process of building the required OIT/SCADA/HMI system. At this meeting, present the actual software displays, databases and alarms. The Owner will make comments on the system for incorporation prior to the testing. Bring a working system to allow for a live demonstration of the graphics.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. The system specified herein shall perform the following generalized functions:
 - 1. The system shall allow the operator to monitor and control systems as shown in the Drawings and as defined in the Control Descriptions.
 - 2. Provide control system diagnostics.

3.02 CONTROLLER PROGRAMS

- A. All applications programs shall be developed in a structured manner and shall follow an intuitive arrangement so that an instrumentation technician with basic programming knowledge will be able to understand. Programs shall utilize standard

program templates or subroutines for repetitive logic such as equipment control, flow total calculations, equipment runtime calculations.

- B. Make changes to the application programs and software configuration, based on comments during the submittals, the field tests, and during the commissioning process to meet the design intent, at no additional cost to the Owner.

3.03 GRAPHIC DISPLAYS - GENERAL

- A. All displays shall contain and continuously update the displayed process variables, date and time of day. All process values shall be displayed in engineering units. All displays shall incorporate references to both instrumentation tag numbers and plant equipment numbers. All process variables shall be displayed on their associated display(s) with correct engineering units. Process variables shall display their associated data quality flags.
- B. All operator commands related to controlling field devices or system attributes shall require multiple keystrokes or mouse actions to protect against inadvertent operations. The operator shall receive confirmation of the selected point to be controlled, at which time a cancellation of the control can be affected.
- C. Process graphic displays shall be based on the P&IDs, site plan drawings, mechanical drawings, and electrical drawings included in these Contract Documents. The graphic displays shall depict process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.
- D. All main graphical screens shall follow the same convention as the existing graphics.
- E. Animation shall be provided to mimic level changes in tanks or vessels, and to mimic rotation of rotating equipment when running. Valve colors shall change when opened and closed.
- F. Unless specifically noted, all timers, setpoints, alarm actuation levels, etc., shall be adjustable from the operator interface.
- G. The system shall show field conditions with text that can alternate (i.e., OPEN/CLOSE, START/STOP, HIGH/LOW) and change color correspondingly. Field devices that are tri state must be represented in three conditions.
- H. Conditions in the field designated as alarm conditions shall report to the operator workstation, actuate an audible alarm, and provide a visual blinking image on the associated graphic page. All alarms and events shall be displayed on the screen and archived.
- I. All interlocks that affect equipment operation shall be identified both by alarm and by HMI indication.
- J. All analog inputs shall be checked for out of range (via high and low limit checks) and alarmed.
- K. All process flow streams shall be labeled and color coded using the project color schedule in Division 09. All structures and equipment shall be identified by name and appropriate equipment and loop tags.

- L. Color coding for equipment status and alarms shall be as per existing standards.
- M. Automatically record all alarm and events should any of the following sequences or events occur:
 - 1. Date/Time entry
 - 2. Limit changes
 - 3. Any commanded or uncommanded change of any point
 - 4. Alarm conditions
 - 5. PLC activation or deactivation
 - 6. Operator login or logout activity
- N. There may be additional general programming requirements stated in Control Descriptions that may impact the SCADA/HMI configuration.

3.04 SECURITY

- A. The OIT/SCADA/HMI screens shall be provided with the appropriate security levels. The screens shall be configured and implemented with security to prevent unauthorized access. The screens shall allow authorized changes to system operation through defined user accounts and password verification.

3.05 ALARM/EQUIPMENT STATUS REPORTING

- A. The alarm log shall display all alarms as they occur. The alarm message shall include the time of occurrence, tag name, tag number, and whether it is a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identification number, and return to normal shall be displayed. All reports shall include the plant equipment number of the associated device.
- B. The equipment status shall be logged whenever a change in status occurs (i.e., start, stop). The equipment status log shall include the time, equipment name, tag number, and the particular change in status.

3.06 TESTING

- A. Refer to Section 13302.
- B. Supplement to Field Testing requirements
 - 1. Prior to leaving the site, use the Owner's programming computer to monitor all PLC processors online, make on-line changes, upload and download the processor to ensure programming software version compatibility.

3.07 TRAINING

- A. Refer to Section 13303 for general training requirements
- B. Furnish training as shown in the table below.

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Control System Overview Seminar	8	4	1	Management
Operator Training (Post start-up)	8	4	1	Operations

C. Control System Overview Seminar

1. Provide Control System Overview seminar for the Owner's personnel at the Owner's facility. The objective of this seminar is to provide personnel with an overview understanding of the Control System. The seminar material shall be targeted to the Owner's management, engineering, and other non-operations personnel. The seminar shall include, but not limited to, the following:
 - a. An overview of the Control system explaining how the hardware and software supplied under this Contract is used for the operation and control of the facilities.
 - b. A block diagram presentation of the Control system showing how and what information flow within the system and what each functional unit does.
 - c. An explanation of the operator interfaces including a demonstration of how to use an operator's workstation to monitor, control, navigate, display trends, and all other operational features of the system. Discussion of process control of individual processes shall be addressed outside of this course.
 - d. A walkthrough of the installed system explaining each of the items covered in the functional units' discussion. The features and functions of operator controls and interfaces shall be discussed.

D. Operator Control System Training (post start-up)

1. Operator training shall cover plant operation with the control system and use of the HMI display screens, including at a minimum all the following items:
 - a. Basics of OIT/SCADA/HMI control and navigation
 - b. Alarming and Interlocks
 - c. Auto functionality of automated processes and OIT/SCADA/HMI control.
 - d. Failure modes of equipment and operator responses.
2. One operator training session (Post-Startup) for operators shall be held one week after system startup.

3. Operator training shall be held at the convenience of the OWNER. This training may be held during the day, late at night, or very early in the morning to accommodate the OWNER'S shift schedule.
4. Operator training shall be in-depth and detailed during post-startup training.
5. At a minimum, the following teaching aids shall be available for distribution during Operator training sessions:
 - a. Preliminary O&M Manuals (pre-startup); Final O&M Manuals (post-startup).
 - b. P&IDs.
 - c. Daily syllabus.
6. Fifty percent of all Operator training shall be "hands on" fully utilizing the installed Control System possible. Confirm the operability of the Control System before commencing training. Training performed using a non-functioning Control System shall be rejected and repeated.

END OF SECTION

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SECTION 13330

CONTROL PANEL ENCLOSURES AND PANEL EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Refer to Section 13300.
- B. Furnish and install control panels and panel mounted equipment as specified herein and shown on the Drawings.
- C. All new panels and panel components shall match existing equipment makes and models wherever possible, so that system additions can be most easily integrated with respect to operation and maintenance training, spare parts inventory, and service contracts. Even when exact matches are not possible, equipment furnished must be fully compatible with the existing system. Color, size, and material of new panels should conform to that of existing panels.
- D. Each panel shall be supplied with full sub-panels with the minimum specified dimensions regardless of the quantity of mounted components inside the panel. All panel mounted components shall be mounted on the single rear-of-panel sub-panel unless the density of devices exceeds the panel mounting space permitted by the minimum panel dimensions specified. Side panel mounted components shall only be permitted after review and approval of the Engineer.

1.02 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED WORK

- A. Refer to Section 13300 "I & C - General Provisions."

1.04 SUBMITTALS

- A. Refer to Section 13300.
- B. Descriptive literature, bulletins, catalog cuts and drawings for the equipment specified herein.
- C. Complete bill of materials for the equipment.
- D. Spare parts list.
- E. Panel Layout Drawings and Wiring Diagrams Submittal:
 - 1. Where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions, Contractor shall provide to PCSS approved submittals in order for PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. These drawings shall be

included in Final O&M submittal. Leaving this information blank on Final Documentation drawings is not acceptable.

2. Panel Layout Drawings: Submit Drawings for all panels, consoles, and equipment enclosures specified. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. Panel drawings shall be 11"x17" in size. At a minimum, the panel drawings shall include the following:
 - a. Interior and exterior panel elevation drawings to scale.
 - b. Nameplate schedule.
 - c. Conduit access locations.
 - d. Panel construction details.
 - e. Cabinet assembly and layout drawings to scale. Assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. Bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.
 - f. Fabrication and painting specifications including color (or color samples).
 - g. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
 - h. For every control panel, heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling.
 - i. Submit evidence that all control panels shall be constructed in conformance with UL 698A and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. Costs associated with obtaining the UL seal and any inspections shall be borne by Contractor.
3. Panel Wiring Diagrams: Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. If ISA Loop Wiring Diagrams are specified below, equipment external to the control panel and related external connections do not need to be shown on the Panel Wiring Diagrams. Panel wiring diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring shall include the device ISA-tag and a unique numeric identifier. Diagrams shall identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer. I/O wiring shall be numbered with rack number, slot number, and point number. Two-wire and four-

wire equipment shall be clearly identified and power sources noted. Submit final wire numbering scheme. Panel drawings shall be 11" x17" in size.

4. ISA Loop Wiring Diagrams: Not required.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300.

1.08 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300.

1.10 MAINTENANCE

A. Refer to Section 13300.

B. Test Equipment:

1. Refer to Section 13300.

1.11 WARRANTY

A. Refer to Section 13300.

PART 2 PRODUCTS

2.01 GENERAL

A. Refer to Section 13300.

2.02 LIGHTNING/SURGE PROTECTION

A. Refer to Section 13300.

2.03 CONTROL PANEL GENERAL REQUIREMENTS

A. Dimensions within this Section and on Contract Drawings are for general reference only. Ensure that final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified herein and in Contract Documents.

B. Each control panel and terminal cabinet shall bear the UL label. UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses, and any other equipment necessary to achieve compliance with UL 698A requirements. The drawings do not detail all UL 698A requirements.

- C. Panel doors shall have a lock installed in door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.
- D. Devices designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment. Heat generating devices such as power supplies shall be located at or near the top of the panel.
- E. Components shall be mounted in a manner that shall permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component mounting shall be oriented in accordance with manufacturer's recommendations. Internal components shall be identified with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawing, specifications, and PCSS's data.
- F. Exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.
- G. Nameplates:
 - 1. Panels and panel devices shall be supplied with suitable nameplates, which identify the panel and individual devices as required. Unless otherwise indicated, each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).
 - 2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, nameplates shall be 3/32-inch thick, black and white, Lamicoid with engraved inscriptions. The letters shall be Black [White] against a White [Black] background unless otherwise noted. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.
 - 3. Nameplate fasteners and mounting shall be stainless steel screws for cabinet mounted nameplates
 - 4. For every panel, provide a panel nameplate with a minimum of 1-in high letters. Provide legend plates or 1-in by 3-in engraved nameplates with 1/4-in lettering for identification of door mounted control devices, pilot lights, and meters.
 - 5. Single lamicoid nameplates with multiple legends shall be used for grouping of devices such as selector switches and pilot lights that relate to one function.
- H. Mounting Elevations:
 - 1. ISA Recommended Practice RP60.3 shall be used as a guide in layout and arrangement of panels and panel mounted components. Dimensions shall account for all housekeeping pads that panels will sit on once they are installed.

2. Centerline of indicators and controllers shall be located no lower than 48-inches or higher than 66-inches above the floor on a panel face.
3. Centerline of lights, selector switches, and pushbuttons shall be located no lower than 32-inches or higher than 70-inches above the floor on a panel face.
4. Tops of annunciators shall be located no higher than 86-inches above the floor on a panel face.
5. Installation of panel components shall conform to component manufacturers' guidelines.

2.04 PANEL MATERIALS AND CONSTRUCTION

A. Structure and Enclosure:

1. Panels shall be of continuous welded-steel or FRP construction as shown on the drawings
2. Provide angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally the panels shall be supplied with a structural framework for instrument support purposes and panel bracing. Internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.
3. Each panel shall be provided with full height, fully gasketed access doors where shown. Doors shall be provided with a three-point stainless steel latch (except for NEMA 4X panels) and heavy duty stainless steel locking handle. Rear access doors (if included) shall be conveniently arranged and sized such that they extend no further than 24-inches beyond the panel when opened to the 90-degree position. Front and side access doors shall be as shown. Panel access doors shall be provided with full length, continuous, piano type stainless steel hinges with stainless steel pins. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments.
4. Panels, including component parts, shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.
5. Panel shall be suitable for top and bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry, panel top shall be provided with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations. Conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.
6. Panels in indoor, dry, non-corrosive environments shall be NEMA 12 unless otherwise noted. Panels in outdoor, wet, and non-chemically corrosive environments shall be NEMA 4 unless otherwise noted. Panels in chemically corrosive environments shall be NEMA 4X unless otherwise noted. Panels

located in a hazardous location shall be rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).

B. Freestanding and Floor-Mounted Vertical Panels:

1. Freestanding and floor-mounted vertical panels shall meet the NEMA classification as shown on the drawings or specified herein. Panels shall be constructed of 12 gauge sheet steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated panels shall be constructed of Type 316 stainless steel, unless FRP is specifically indicated to be provided. Front panels or panels containing instruments shall be not less than 10 gauge stretcher leveled sheet steel, reinforced to prevent warping or distortion.

C. Wall and Unistrut Mounted Panels:

1. Wall and Unistrut mounted panels shall meet the NEMA classification as shown on the Drawings or specified herein. Panels shall be constructed of not less than USS 14 gauge steel, suitably braced internally for structural rigidity and strength. NEMA 4X rated wall mounted panels shall be constructed of Type 316 stainless steel, unless FRP is specifically indicated. FRP panels shall be used in chlorine areas. FRP panels located in direct sunlight shall be provided with a protective coating and sun shield to prevent discoloration and cracking.

D. Finish Requirements:

1. Sections shall be descaled, degreased, filled, ground and finished. Enclosure when fabricated of steel shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.
2. Panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.
3. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sand-ing shall be applied to the intermediate exterior coat before top coating.
4. Apply a minimum of two coats of manufacturer's standard, flat light-colored lacquer, on the panel interior after priming.
5. Unless otherwise noted, the finish exterior colors shall be ANSI 61 gray with a textured finish.

E. Print storage pockets shall be provided on the inside of each panel. Storage pockets shall be steel, welded on to the door, and finished to match the interior panel color. Storage pocket shall be sufficient to hold all of the prints required to service the equipment, and to accommodate 8.5 inch by 11 inch documents without folding.

F. Where specified on the drawings, a folding shelf shall be provided on the inside of the door on all free-standing and floor-mounted panels. Shelf shall be suitable for a laptop computer and shall be placed such that an open laptop computer does not

interfere with any door-mounted devices. Folded shelf shall not interfere with any internal panel components when the door is closed. Folding shelf shall automatically lock in the horizontal position when raised. Folding shelf shall be approximately 18 inches wide by 12 inches deep and shall have a minimum distributed load rating of 100 pounds. Parts shall be made of heavy gauge steel and shall be painted white or finished to match the interior panel color.

2.05 ENVIRONMENTAL CONTROL

- A. Panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditioning units as required to prevent temperature buildup inside of panel. Internal temperature of all panels shall be regulated to a range of 45 Deg F to 104 Deg F under all conditions. Under no circumstances shall panel cooling or heating equipment compromise the NEMA rating of the panel.
- B. PCSS to perform and submit thermal calculations for each supplied control panel for review by the Engineer to support the use of their proposed environmental control device.
- C. Except for panels mounted with their backs directly adjacent to a wall, louvers shall be in the rear of the panels, top and bottom, and shall be stamped sheet metal construction.
- D. For panels mounted with their backs directly adjacent to a wall, louvers shall be on the sides.
- E. Forced air ventilation fans, where used, shall provide a positive internal pressure within the panel, and shall be provided with washable or replaceable filters. Fan motors shall operate on 120-volt, 60-Hz power.
- F. For panels with internal heat that cannot be adequately dissipated with natural convection and heat sinks, or forced air ventilation, an air conditioner shall be provided.
- G. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:
 - 1. Sun shields shall be fabricated from minimum 12 gauge Type 316 stainless steel. Units shall be designed, fabricated, installed, and supported to fully cover and shade the top, sides and back of the enclosure, and to partially shade the front panel of the enclosure, from direct exposure to sunlight from sunrise to sunset.
 - 2. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure.
 - 3. Sun shields shall not be attached directly to the enclosure by drilling holes through, or welding studs to, the enclosure surfaces, and shall be designed and mounted to provide a minimum 3-inch air gap all around the enclosure for air circulation and heat dissipation.
 - 4. Top section of all sun shields shall be sloped at a minimum angle of 5 degrees from horizontal. For wall mounted enclosures, the top section shall slope

downward away from the wall and towards the front of the enclosure. For free standing, floor mounted and frame mounted enclosures the top section shall slope downward towards the back side of the enclosure.

5. Front edge of the top section of all sun shields shall incorporate a narrow and more steeply sloped drip shield segment which sheds water away from the front of the enclosure and prevents it from dripping or running directly onto the front panel of the enclosure.
 6. Seam welds used in sun shield fabrication shall be continuous and shall be ground smooth.
 7. Exposed corners, edges, and projections shall be smooth rounded or chamfered to prevent injury.
- H. Outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture shall be provided with an integral heater, fan, and adjustable thermostat to reduce condensation and maintain the minimum internal panel temperature. Mount unit near bottom of the enclosure with discharge away from heat-sensitive equipment. Heater shall be Hoffman DAH 100 Watts, 115 Volt, 60 HZ or equal.

2.06 CORROSION CONTROL

- A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Technologies International Corporation, Model Zerust VC; Hoffman Model AHCI; or equal.

2.07 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring:

1. Interconnecting wiring shall be stranded, type MTW, and shall have 600 volt insulation and be rated for not less than 90 degrees Celsius. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.
2. Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 16 AWG minimum. Electronic analog circuits shall utilize 18 AWG shielded, twisted pair, cable insulated for not less than 600 volts.
3. Power distribution blocks shall be covered with protective guards to meet "finger-safe" requirements of IP20.
4. Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6-inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent visible fill.

5. Terminations:
 - a. Wiring shall terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable.
 - b. Multi-level terminal blocks or strips are not acceptable unless they are approved by the Engineer in advance of panel wiring diagrams. If approved, they shall be mounted on angled din rail elevated from the back panel.
 - c. Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Each group of terminal blocks shall have a minimum of 25 percent spares.
 - d. Terminal blocks shall be the compression type, fused, unfused, or switched as shown on the Contract Drawings or specified elsewhere in Division 13.
 - e. Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments. All active and spare PLC and controller points shall be wired to terminal blocks.
 - f. Analog inputs and outputs (AI and AO) shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Ground the shielded signal cable at the PLC cabinet. All active and spare PLC and controller points shall be wired to terminal blocks.
 - g. Wire and tube markers shall be the sleeve type with heat impressed letters and numbers.
 - h. Only one side of a terminal block row shall be used for internal wiring. Field wiring side of the terminal shall not be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.
 - i. Circuit power from the SCADA cabinet out to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards shall be isolated with an isolating switch terminal block with flip cover that is supplied with a dummy fuse. Isolation switch block shall be an Allen Bradley Model 1492-H7 or equal. One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.
 - j. All PLC discrete outputs to the field shall be isolated with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator. The single circuit fusible terminal block shall be an Allen Bradley 1492-H4 or equal.
6. Wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection, shall be clearly identified as such.
7. Wiring shall be clearly tagged and color coded. Tag numbers and color coding shall correspond to panel wiring diagrams and loop drawings prepared by the

PCSS. Power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. Color coding scheme shall be:

- a. Incoming 120 VAC Hot – Black.
 - b. 120 VAC Hot wiring downstream of panel circuit breaker – Red.
 - c. 120 VAC Hot wiring derived from a UPS system – Red with Black stripe.
 - d. Three phase power – Brown, Orange, Yellow, and Green ground or as specified in Division 16.
 - e. 120 VAC neutral – White.
 - f. Ground – Green.
 - g. DC power or control wiring – Blue.
 - h. DC analog signal wiring – Black (+), White (-).
 - i. Foreign voltage – Yellow.
8. Provide surge protectors on all incoming power supply lines at each panel per requirements of Section 13300.
 9. Each field instrument furnished under Division 13 and shown on the Drawings as deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication. Instruments requiring 120VAC power shall be powered from the UPS source in the panel where the instrument signals lands.
 10. Provide redundant 24 VDC power supplies to power field instruments and panel devices. Twenty-four VDC power supplies shall be as specified in this Section.
 11. Wiring trough for supporting internal wiring shall be plastic type with snap-on covers. Side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.
 12. Each panel shall have a single tube, fluorescent light fixture, 20 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.
 13. Each panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box

with appropriate cover. Convenience receptacle shall not be powered from a UPS and shall be protected by a dedicated fuse or circuit breaker.

14. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.
 15. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
 16. Each panel shall have control, signal, and communication line surge suppression in accordance with Section 13300.
 17. Microprocessor-based electronic devices in the panel that are powered by 120VAC shall be powered by the UPS (refer to appropriate Section in Division 13).
 18. Each panel shall be provided with a circuit breaker to interrupt incoming power.
 19. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. shall be in compliance with the requirements of Division 16.
- B. Relays not provided under Division 16 and required for properly completing the control function specified in Division 13, Division 16, or shown on the Drawings shall be provided under this Section.
- C. Orientation of devices including PLC and I/O when installed shall be per the manufacturer's recommendations. No vertical orientation of PLC racks shall be allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and also approved by the Engineer.

2.08 ELECTRICAL COMPONENTS

- A. Main circuit breaker shall be a thermal-magnetic molded case breaker, by Square D Company, or equal. Provide a flange mounted main power disconnect operating handle with mechanical interlock having a bypass that will allow the panel door to open only when the switch is in the OFF position.
- B. A mechanical disconnect mechanism, with bypass, shall be installed on each motor circuit protector, capable of being locked in the "OFF" position to provide a means of disconnecting power to the motor.
- C. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by the detailed mechanical equipment requirements, the Control Wiring Diagrams and as shown on the Drawings.
- D. Operating control devices and instruments shall be securely mounted on the exterior door. Controls shall be clearly labeled to indicate function and shall be in accordance with the electrical area classification indicated on the Electrical Contract Drawings.

- E. A six digit, non-resettable quartz time base elapsed time meter shall be connected to each motor starter. Meter shall be Hobbs 98000 Series, Redington Model 722, Cramer Model ETI-635 G, or equal.
- F. Control panel shall be provided with a lightning and surge protection unit on the line side of the main circuit breaker. Unit shall be 600 Volt, 3 Phase, General Electric "Tranquell" Series, or equal.
- G. Where required by Specifications, an alternator shall be provided to sequence motors. Alternator shall be Catalog No. 008-120-13SP or 009-120-23AP by Stacon; Square D, Class 9039, Type HG-21 or equal.
- H. Panel mounted timers shall be flush mounted, plug-in type, Eagle Signal Bulletin 125 cycle-flex, Idec SR6P-MO8G or equal, with ranges as shown on the Drawings, or as required by the detailed mechanical equipment specifications.
- I. Specific control devices, control descriptions and other data are specified under the detailed specification for the mechanical equipment with which the control panel is supplied.

2.09 PILOT TYPE INDICATING LIGHTS

- A. Type: Energy efficient Solid State LED Lamps.
- B. Functional:
 - 1. Units shall be provided with low voltage LED lamps suitable for the voltage supplied.
 - 2. Lights supplied with 120V AC power shall have integral reduced voltage transformers.
 - 3. Lamps shall be replaceable from the front of the unit.
 - 4. Lamps shall be push-to-test (PTT)
- C. Physical:
 - 1. Lens color:
 - a. Running, on, open - Green.
 - b. Stopped, off, closed - Red.
 - c. Alarm - Amber.
 - d. White - Power on.
 - e. Blue - All other status indications not covered by the above.
 - f. Lens caps shall be approximately .46 inch diameter. Provide legend faceplates engraved to indicate the required function of each device; NEMA rating - 4X.
- D. Manufacturer(s):
 - 1. Cutler-Hammer.
 - 2. Allen Bradley.

3. General Electric.
4. Square D.
5. Crouse Hinds (NEMA 7).
6. Or equal.

2.10 SELECTOR SWITCHES AND PUSHBUTTONS

A. Type:

1. Control devices shall be heavy-duty oil tight type with stackable contact blocks.

B. Functional:

1. Provide contact arrangement and switching action as required for the control system specified.

C. Physical:

1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide silver sliding contacts rated 5 amps at 125 VDC, for electronic (millivolt/ milliamp) switching provide contacts rated lamp at 28 VDC.
2. Pushbuttons shall have flush type operators.
3. Selector switches shall have knob or wing lever operators; NEMA rating - 4X; Provide legend plates denoting switch/pushbutton position/ function.

D. Manufacturer(s):

1. Cutler-Hammer.
2. Allen Bradley.
3. General Electric.
4. Square D.
5. Crouse Hinds (NEMA 7).
6. Or equal.

2.11 POTENTIOMETER

A. Type:

1. Device shall be heavy-duty 30 mm oil tight type.

B. Functional:

1. 270 degree dial.
2. Rated for 1,000 ohms.

C. Physical:

1. Mounting: Suitable for panel mounting.
2. NEMA 4X rating; escutcheon plates scaled in engineering units.

D. Manufacturer(s):

1. Allen Bradley Co.
2. Cutler-Hammer.
3. Square D.
4. Or equal.

2.12 GENERAL PURPOSE RELAYS AND TIME DELAYS

A. Type:

1. General purpose plug-in type.

B. Functional:

1. Contact arrangement/function shall be as required to meet the specified control function; Mechanical life expectancy shall be in excess of 10 million.
2. Duty cycle shall be rated for continuous operation; Units shall be provided with integral indicating light to indicate if relay is energized.
3. Solid state time delays shall be provided with polarity protection (DC units) and transient protection.
4. Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.

C. Physical:

1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide contacts rated 5 amps at 28 VDC, for electronic (milliamp/millivolt) switching applicator provide gold plated contacts rated for electronic service; relays shall be provided with dust and moisture resistant covers.

D. Options/Accessories Required:

1. Provide mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps.
2. Provide mounting rails/holders as required.

E. Manufacturer(s):

1. Allen Bradley.
2. Potter & Brumfield.
3. Or equal.

2.13 SIGNAL RELAY SWITCHES (CURRENT TRIPS)

A. Type:

1. Solid state, ASIC technology, electronic type.

B. Functional:

1. Input: 4-20 mA.
2. Output: Isolated contact output, double pole double throw, rated 5 amps at 120 VAC.
3. Accuracy: 0.1 percent.
4. Protection: Provide RFI protection.
5. Deadband: Adjustable between 0.1 and 5.0 percent of span.
6. Set point Adjustment: Single Point alarms shall be adjustable to trip on rising or falling input signal, dual point alarms shall be adjustable to trip on rising and falling input signals.
7. Repeatability: Trip point repeatability shall be at least 0.1 percent of span.

C. Physical:

1. Mounting: DIN rail.

D. Manufacturer(s):

1. Action Instruments Slim Pak.
2. Acromag.
3. Or equal.

2.14 SIGNAL ISOLATORS/BOOSTERS/CONVERTERS

A. Type:

1. Solid state, ASIC technology; electronic type.

B. Functional:

1. Accuracy: 0.15 percent.
2. Inputs: Current, voltage, frequency, temperature, or resistance as required.
3. Outputs: Current or voltage as required.
4. Isolation: There shall be complete isolation between input circuitry, output circuitry, and the power supply.
5. Adjustments: Zero and span adjustment shall be provided.
6. Protection: Provide RFI protection.

C. Physical:

1. Mounting: DIN Rail.

D. Manufacturer(s):

1. Action Instruments Slim Pak.
2. Acromag.
3. Or equal.

2.15 SIGNAL SELECTORS, COMPUTATION AND CONDITIONING RELAYS

A. Type:

1. Solid state, ASIC technology, electronic type.

B. Functional:

1. Inputs: 4-20 mA.
2. Outputs: 4-20 mA.
3. Protection: Provide RFI protection.
4. Operation: The relay shall multiply, add, subtract, select, extract the square root, or perform the specified conditioning/ computation function required. All inputs shall be able to be individually rescaled and biased as required.
5. Isolation: All inputs, outputs, and power supplies shall be completely isolated.
6. Accuracy: 0.35 percent of span.
7. Adjustments: Multi turn potentiometer for zero, span, scaling, and biasing.

C. Physical:

8. Mounting: DIN rail.

D. Manufacturer(s):

1. Action Instruments Slim Pak.
2. Acromag.
3. Or equal.

2.16 INTRINSIC SAFETY BARRIERS

A. Type:

1. Barriers shall be of the solid state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe usage in hazardous areas.
2. Provide a barrier for instrumentation and equipment transmitting analog or digital signals that originate in a hazardous area as indicated in the design documents.

B. Options Required:

1. Barriers shall match power supply provided.
2. Barriers shall be located in non-hazardous areas.

C. Manufacturer(s):

1. Siemens Water Technologies – IS1 (4-20mA) and IS6 (dry contacts).
2. Gems – 54800 (4-20mA) and 65800 (dry contacts).
3. R. Stahl - Intrinspak
4. Or equal.

2.17 EMERGENCY ALARM BEACON AND AUDIBLE HORN

A. Beacon alarm light:

1. Type:
 - a. Beacon alarm light.
1. Physical:
 - a. Beacon alarm light for building exterior mounting shall be 120 VAC, flush mounted, weatherproof construction.
 - b. A 750,000-candle power xenon strobe tube and red polycarbonate lens.
1. Manufacturer(s):
 - a. Federal Signal.
 - b. Edwards.
 - c. Wheelock.
 - d. Or equal.

B. Alarm Horn:

1. Type:
 - a. Alarm horn shall be vibrating type for 120 Volts, 60 Hz.
2. Manufacturer(s):
 - a. Federal Signal Corp.
 - b. Edwards Co.
 - c. Benjamin.
 - d. Or equal.

2.18 INTRINSIC SAFETY BARRIERS (FOR 2 WIRE TRANSMITTER SYSTEMS)

- A. Intrinsic safety barriers shall be passive devices requiring no external voltage supply and supplied with series resistors, series fuse and shunt zener diodes to limit the transfer of energy to levels required by intrinsically safe protection between safe and hazardous locations.
- B. Unit shall be Factory Mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493).
- C. Manufacturer(s):
 1. P&F.
 2. Gems.
 3. Unitech.
 4. Or equal.

2.19 24 VDC POWER SUPPLIES

- A. Provide a 24 VDC power supply in the control panel to power field instruments, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.
- B. The 24 VDC power supply shall meet the following requirements:
 - 1. Input power: 115 VAC, plus or minus 10 percent, 60 Hz.
 - 2. Output voltage: 24 VDC.
 - 3. Output voltage adjustment: 5 percent.
 - 4. Line regulation: 0.05 percent for 10 volt line change.
 - 5. Load regulation: 0.15 percent no load to full load.
 - 6. Ripple: 3 mV RMS.
 - 7. Operating temperature: 32 to 140 degrees Fahrenheit.
- C. Size the 24 VDC power supply to accommodate the design load plus a minimum 25 percent spare capacity.
- D. If power supply on/off status signal is shown, provide a relay contact (internal to the power supply or external if the power supply is not so equipped) to indicate on/off status of the power supply.
- E. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.
- F. Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.
- G. Manufacturer(s):
 - 1. Acopian.
 - 2. Lambda.
 - 3. Or equal.

2.20 DIGITAL PANEL METER

- A. Type:
 - 1. Electronic, 3.5-digit, 0.56-inch high efficiency LED display.
- B. Operation:
 - 1. To accept 4-20 mA DC input signal and provide indication in engineering units of measured variable.
- C. Functional:
 - 1. Accuracy: +/-0.25% of calibrated range.
 - 2. Power supply: 115 VAC, +/- 10 %, 50/60 Hz, 10 VA.
 - 3. Indication: 0.56-inch LED display.
 - 4. Operating Temperature: -20° to 70°C.

5. Input: 4 to 20 mA.
6. Output: retransmitted 4 to 20 mA.
7. Digital Outputs: 2 Form C programmable contacts rated for 5A at 120/240 VAC.
8. Display: 5-digit LED display.
9. Indicator Failure: Failure of the indicator will not cause failure of the 4-20 mA loop.

D. Physical:

1. Case size nominal 2.5-inch high by 5-inch wide by 6-inch deep.
2. Case type: watertight and dust-tight (NEMA 4X) and explosion-proof approved for Class I, Division 1, Groups C and D areas.
3. Mounting: flush panel suitable for high density mounting arrangements.
4. Programmable via integrated keypad.

E. Performance: Linear input accuracy +/- 0.05 % of calibrated span, +/- 1 count.

F. Manufacturer(s):

1. Precision Digital.
2. Red Lion Controls PAXDP Series.
3. Or equal.

2.21 SPARE PARTS

A. General requirements for spare parts are specified in section 13300.

B. The following control panel spare parts shall be furnished:

1. Relays and sockets - Two of each type installed.
2. Fuses and circuit breakers - 10% (minimum of 10 fuses and 2 circuit breakers) of each type and size installed.
3. Light bulbs - 10% (minimum of 10) of each type installed. For LED type lights, 5% (minimum of 3) of each color installed.
4. Panel Mounted power supplies - one of each type installed.
5. Selector switches/pushbuttons - Two of each type installed including contact blocks.
6. Provide touch-up paint, of each type and color used for all cabinets, panels, and consoles supplied.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Panels shall be installed at locations as shown on the Contract Drawings.
- B. Refer to Section 13300.

3.02 TESTS

A. Refer to Section 13300.

END OF SECTION

SECTION 13335

CONTROL PANEL UNINTERRUPTIBLE POWER SUPPLY (SINGLE-PHASE)

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Labor, equipment, supervision and materials for the installation, testing, startup, and training for the uninterruptible power supply (UPS) as shown on the Drawings and as specified herein.

1.02 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED WORK

- A. Section 16010.
- B. Section 16140.

1.04 SUBMITTALS

- A. Submittals shall be in accordance with Division 01 and Section 13300. Submittals shall include shop drawings and product data, for the following:
 - 1. Product brochure.
 - 2. Bill of materials listing all components provided.
 - 3. Deviation list indicating all proposed exceptions.
 - 4. Power single line and control schematics drawings. External connection details and their terminal block locations shall be fully detailed. Internal wiring shall include terminal numbers and color coding.
 - 5. UPS performance specifications:
 - a. kVA rating.
 - b. Input and output voltage and phase.
 - c. Run time at full and half load.
 - d. Voltage (output regulation, input tolerance, unbalance, transfer/retransfer voltage, etc.).
 - e. Heat rejection.
 - 6. Operating Instruction manuals and recommended replacement parts.
 - 7. Name, address, and telephone number of the nearest service facility.
 - 8. Training agenda and information per Section 13303.
 - 9. Battery specifications and warranty.

10. UPS Loading and battery sizing calculations to support runtimes as specified herein.

1.05 REFERENCE STANDARDS

- A. ANSI C62.41/IEEE 587 - Standards for Surge Withstandability.
- B. FCC (Federal Communications Commission) Rules and Regulations, Part 15, Subpart B, Class A certified compliance.
- C. UL (Underwriters Laboratories) 1778 Listed (Rev. Jan 5, 2000), UL497A.
- D. CSA 22.2, No. 107.1 M95 AND 107.2.
- E. IEC 62040-2 Emission and Immunity.
- F. IEC 62040-3 (Uninterruptible Power Systems, Part 3).
- G. EN 60529 Equipment Protection.
- H. National Electric Code (NFPA-70).
- I. ISO 9001.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Provide delivery, storage and handling in accordance with Section 01600 and per the following:
 - 1. Store equipment indoors in a clean, dry, heated storage facility until ready for installation. Do not install equipment in its final location until the facilities are permanently weather tight. Furnish, install and wire temporary electric space heaters in the equipment until permanent heating equipment is operational. Protect equipment at all times from exposure to moisture and chemicals.

1.07 QUALITY ASSURANCE

- A. UPS systems shall utilize a field proven design. UPS manufacturer shall demonstrate at least ten years of continuous field operating experience with equipment of similar size and design.
- B. A factory authorized service and parts organization shall be located within 100 miles of the project location. Submit name and address of factory authorized service and parts organization. Manufacturer shall have a complete selection of service options that may include onsite service by factory-employed service engineers and factory depot quick-return service plan options.
- C. Equipment shall be UL or ETL labeled.
- D. UPS manufacturer shall have ISO 9001 certification.
- E. UPS system shall meet or exceed theoretical Mean-Time-Between-Failures (MTBF) for a Single module UPS operation (represents UPS module operation only) of 140,000 MTBF hours.

1.08 WARRANTY

- A. Refer to Division 01.

- B. UPS: In addition to basic warranty, UPS manufacturer shall provide a standard warranty for UPS for a period of one year from date of purchase. Contractor shall provide an additional one-year extended warranty to cover delays associated with equipment startup or date of receipt by end user, whichever occurs first.
- C. Battery: In addition to basic warranty, UPS manufacturer shall provide a standard warranty for batteries for a period of one year from date of purchase. Contractor shall provide an additional one-year extended warranty to cover delays associated with equipment startup or date of receipt by end user, whichever occurs first.

PART 2 PRODUCTS

2.01 SINGLE PHASE UPS - INTERNAL TO CONTROL PANELS

A. System Description:

- 1. Provide an industrially rated continuous duty, on-line, solid state, line interactive, single-phase uninterruptible power system.
- 2. UPS shall provide power conditioning and power backup for PLC, communications hardware, and other critical electronic loads as indicated on Drawings.
- 3. UPS system shall consist of the following major components:
 - a. Rectifier and battery charger.
 - b. Inverter.
 - c. Batteries.
 - d. Other features as described in this Section and as indicated on Drawings.
- 4. UPS shall be:
 - a. Allen Bradley 1609-U UPS.
 - b. Sola Hevi Duty SDU UPS.
 - c. Eaton 9PX
 - d. APC
 - e. Or equal.

B. General Requirements:

- 1. Battery protection shall be provided with an internal circuit breaker disconnect.
- 2. Current limiting circuitry shall protect inverter output under any load condition.
- 3. AC output neutral shall be electrically isolated from UPS chassis. UPS chassis shall have an equipment ground terminal. Provisions for installation of a bonding connector shall be provided.
- 4. UPS shall be suitable for installation in a UL508A listed panel.
- 5. UPS shall be DIN rail mountable.

6. UL recognized components for industrial applications in accordance with UL508 without derating.
- C. Performance Requirements:
 1. Ratings:
 - a. Output power: 1000VA - 1500VA.
 - b. Battery runtime: 30 minutes at full-load, 60 minutes at half-load.
 2. Environment:
 - a. Ambient temperature: 0 to 40 degrees C.
 - b. Elevation: Up to 500-ft above mean sea level.
 - c. Relative humidity: 1 to 95 percent non-condensing.
 3. System Input - Primary source:
 - a. Single input: Nominal Input Voltage: 120 VAC.
 - b. Frequency: 45 to 65 Hz.
 - c. Input Power Factor: 0.95 lag minimum, 50 to 100 percent load.
 - d. Input Surge Withstandability: Per IEEE 587/ANSI C62.41. Category A and B, (6 kV).
 4. System Output:
 - a. Nominal Output Voltage: 120 VAC
 - b. Frequency: 60 Hertz plus or minus 3 Hertz.
 - c. 100 percent load with 3:1 Crest Ratio
 - d. Frequency Slew Rate: 1 Hz/second. (Adjustable at startup)
 5. AC to AC Efficiency (100 percent load @ rated PF): 88 percent online, 86 percent on battery.
 6. Acoustical Noise: Noise generated by UPS under normal operation shall not exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 25 degrees C (77 degrees F) and full load.
 7. EMI Suppression: UPS shall meet FCC Rules and Regulation 47, Part 15, Subpart J, for Class A devices.
- D. Modes of Operation:
 1. UPS shall operate as a line interactive on-line, fully automatic system in the following modes:
 - a. Normal: Critical load shall be continuously supplied with filtered and regulated AC power by inverter. Rectifier/battery chargers shall derive power from preferred AC source and supply DC power to inverter while simultaneously floats charge the batteries.

- b. Emergency: Upon failure of preferred AC power source, critical load shall continue to be supplied by inverter. Inverter power shall be supplied without switching from storage battery. There shall be no interruption to critical load upon failure or restoration of preferred ac sources. If AC source cannot be restored before battery discharges to its low voltage dropout value, UPS shall automatically shut itself down in an orderly manner.
- c. Recharge: Upon restoration of AC source, rectifier/battery charger shall power inverter and simultaneously recharge batteries. This shall be an automatic function causing no interruption to critical load.

E. Rectifier/Charger:

- 1. Term rectifier/charger shall denote solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to inverter and for battery charging. Rectifier/charger shall be a solid-state SCR/IGBT power transistor type with constant voltage/current limiting control circuitry.

F. Inverter:

- 1. Inverter shall include all solid-state equipment and controls to convert DC power from rectifier/charger or battery to a regulated AC power for powering critical load. Inverter shall use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.
- 2. Inverter shall be capable of supplying current and voltage for overloads exceeding 100 percent. Inverter is to provide 150 percent of full load for 30 seconds and 125 percent of full load for 2 minutes. A status indicator and audible alarm shall indicate overload operation.
- 3. Output voltage shall be maintained to within plus or minus 5 percent.
- 4. Output voltage total harmonic distortion (THD) shall not be greater than 5 percent at full load.

G. Batteries:

- 1. Batteries shall be High Temperature sealed, maintenance-free, high-rate discharge, lead-acid cells suitable for use indoors with no off gassing, or water addition requirements. Batteries shall not require special ventilation. Battery shall consist of one or more battery banks with number of cells required to meet requirements of rest of these specifications.
- 2. Battery Design Life: two - four years.

H. Controls and Monitoring:

- 1. Microprocessor-controlled circuitry: Fully automatic operation of UPS shall be provided through use of a microprocessor-based controller. Operating and protection parameters shall be firmware-controlled. Logic shall include system test capability to facilitate maintenance and troubleshooting. Startup, battery charging, and transfers shall be automatic functions.

2. Front Indicators: As a minimum, the following indicators shall be provided on UPS control panel:
 - a. On-line (UPS is using utility power to power the load).
 - b. In bypass mode.
 - c. On battery.
 - d. Overload.
 - e. Replace battery / battery disconnected.
 - f. Fault.
 - g. Bar graph for utility voltage.
 - h. Bar graph for battery.
3. Front Panel Controls: As a minimum, the following controls shall be provided on UPS control panel:
 - a. Power On/Off.
 - b. Self-test.
 - c. Alarm silence.
 - d. Cold start.
 - e. Load off.
4. Remote alarm and status indication: Isolated SPDT dry contacts shall be provided and connected to the PLC /RIOs to indicate UPS status for remote monitoring. Contacts shall be rated for 250VAC @ 5A or 30VDC @ 5A Individual contacts shall be provided for separate annunciation of the following alarm and status conditions:
 - a. UPS Fail.
 - b. Battery Alarm.
 - c. UPS in Line.

2.02 24VDC UNINTERRUPTIBLE POWER SUPPLY

A. Type:

1. 24 VDC uninterruptible primary switched mode power supply unit.

B. Operation:

1. To provide uninterrupted 24 VDC power to output upon loss of input power.
2. When 24 V supply voltage is applied, connected battery module is charged.
3. In event of a supply voltage failure, battery module is connected to the output, and stored power ensures that all connected devices continue to operate without interruption. UPS supplies a 24 VDC voltage with a load current up to 10 A.

C. Functional:

1. Input voltage range: 22.5 - 30 VDC.
 2. Nominal Output Voltage: 24 VDC.
 3. Output Current: 10 A.
- D. Controls:
1. Dry contacts shall be provided for remote monitoring of UPS conditions:
 - a. UPS on battery.
 - b. Fault.
- E. Physical:
1. Mounting: horizontal DIN rail mounting.
 2. Operating temperature range: 0 - 50 degrees C.
 3. Degree of protection: IP20.
- F. Performance: UPS shall provide a minimum of 15 minutes of run time for calculated full load. Unit may have either internal or external batteries as necessary to support runtime requirements.
- G. Manufacturer(s):
1. Phoenix Contact Quint Series.
 2. Siemens SITOP Series with signaling contact module.
 3. Sola HD Series.
 4. Or equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and connect equipment in accordance with manufacturer's instructions.
- B. Remove temporary lifting angles, lugs, and shipping braces.
- C. Touch up damaged paint finishes.

3.02 FACTORY TESTING

- A. Prior to shipment, complete UPS system shall undergo manufacturer's standard factory test.

3.03 FIELD TESTING

- A. Perform the following minimum test and checks:
 1. Verify that connections are completed in accordance with shop drawings.
 2. Verify supply voltage and phase sequence are correct.
 3. Check mechanical interlocks for proper operation.
 4. Test ground connections for continuity and resistance.

5. Check control circuit interlocking and continuity.
- B. Submit test plan for review and approval.
- C. For UPSs rated 3 - 6kVA, manufacturer's field service technician shall perform startup and adjustment of UPS in accordance with manufacturer's written instructions. Submit a copy of field report containing verification of all startup tests and adjustments performed.
- D. Contractor shall include testing of battery runtime under full load with loss of AC power.
- E. Perform all additional tests required by Division 16 for Electrical Acceptance Testing.
- F. In the event of an equipment fault, notify Engineer immediately. After cause of fault has been identified and corrected, a joint inspection of equipment shall be conducted by Contractor, Engineer, and equipment manufacturer's factory service technician. Repair or replace equipment as directed by Engineer.

3.04 ADJUSTMENT

- A. Make UPS adjustments necessary for manual and automatic operation of entire system.

3.05 CLEANING

- A. Remove rubbish and debris from inside and around equipment. Remove dirt, dust, or concrete spatter from interior and exterior of equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.06 TRAINING

- A. Provide training of staff in accordance with Division 01 and Section 13303.

END OF SECTION

SECTION 13340

PROCESS CONTROL INSTRUMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers the furnishing, installation, and services for instruments.
- B. Vendor-provided instruments as indicated on the drawings, shall conform to these specifications.
- C. Furnish and install instruments with surge protection, sun shields, and any other requirements as applicable, as detailed in Section 13300 - I&C General Provisions.
- D. Contractor shall field verify the installation location and coordinate with other disciplines before ordering the required mounting brackets for the instruments. Contractor must confirm that this coordination has taken place prior to submittal.

1.02 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED WORK

- A. Refer to Section 13300 "I & C - General Provisions."

1.04 SUBMITTALS

- A. Submit complete documentation of all field instruments using ISA-TR20.00.01-2007 (updated in 2004-2006) data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment. The list shall be sorted by Loop Number.
- B. Submit separate data sheets for each instrument including:
 - 1. Plant Equipment Number and ISA tag number per the Drawings.
 - 2. Product (item) name used herein and on the Drawings.
 - 3. Manufacturer's complete model number.
 - 4. Location of the device.
 - 5. Input - output characteristics.
 - 6. Range, size, and graduations in engineering units.
 - 7. Physical size with dimensions, enclosure NEMA classification and mounting details in sufficient detail to determine compliance with requirements.
 - 8. Materials of construction for enclosure and wetted parts.
 - 9. Instrument or control device sizing calculations where applicable.
 - 10. Certified calibration data for all flow metering devices.
 - 11. Two-wire or four-wire device type as applicable.

- C. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.
- D. Submit index and data sheets in electronic format as well as hard copies in 8-1/2" x 11" formats. The electronic format shall be in Microsoft Excel or Word. Submit an electronic copy on CD-ROM or DVD disk.

1.05 MAINTENANCE

- A. Refer to Section 13300.

1.06 PRODUCT HANDLING

- A. Delivery, storage, and handling of equipment shall be in accordance with Division 01 - Basic Product Requirements and as specified herein.
- B. All equipment and parts must be properly protected against any damage during shipment. Store the equipment in accordance with Manufacturer's recommendations.
- C. All completely assembled units shall be offloaded by the use of a primary and "tail" crane system. Additionally, when lifting the units from a horizontal position to a vertical position, the use of a primary and "tail" crane system shall be used.
- D. Long-Term Storage:
 - 1. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of fabrication, including storage in accordance with the Manufacturer's requirements until the unit and equipment are ready for operation.
 - 2. If long-term storage is required on-site, Subcontractor shall follow Manufacturer's detailed recommendations for long-term storage.
- E. Factory-assembled parts and components less than 25 feet in length shall not be dismantled for shipment unless permission is received in writing from the Engineer/Owner.
- F. For units greater than 25 feet in length that are shipped unassembled, all connecting parts shall be "match-marked" by the Manufacturer to ensure correct assembly on-site by the Subcontractor.
- G. The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank flanges, strongly built, and securely bolted thereto.
- H. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- I. No shipment shall be made until approved by in writing.

1.07 WARRANTY

- A. All equipment supplied under this Section of the Specifications shall be warranted by the Equipment Manufacturer for the warranty period specified in Division 01 – Basic Product Requirements.

- B. The Project Warranties Period shall commence on the Date of Substantial Completion. Substantial Completion will be determined and approved by the Owner Project Director.
- C. 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 in the machine(s) and the unit(s) restored to service at no expense to the Owner.
- D. The Manufacturer's warranty period shall run concurrently with the Subcontractor's warranty period. No exception to this provision shall be allowed.
- E. Refer to Division 01 - Closeout Procedures for additional warranty requirements.

1.08 INSTRUMENT TAGS

- A. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as indicated in the Drawings, shall be provided on each piece of equipment supplied under this Section and related sections. Equipment shall be tagged before shipping to the site.
- B. Provide 1/8-in by 3/8-in, Type 316 stainless steel button head machine screws.
- C. All supplied instrument transmitters and instrument transmitter elements shall have a stainless steel identification tag attached to each transmitter and element prior to shipment. Tag shall be attached via stainless steel chain or stainless steel wire (24 gauge min) to a non-removable part of the device. The tag size shall be a minimum of 1.5 square inches. Tag shall include the ISA alphanumeric instrument number as indicated in the P&ID, loop, and detail drawings. The alphanumeric instrument number shall be stamped into the tag and shall have a minimum of 3/16-in high alphanumeric characters.

1.09 APPROVALS/CERTIFICATIONS

- A. Instruments for hazardous locations shall have Factory Mutual (FM), Canadian Standards Association (CSA), and CENELEC approvals and certifications as specified herein and as indicated on the Drawings or in the Instrument Device Schedule. The instrument specifications in Part 2 state the Class, Division, and gas groups for FM/CSA approval, followed in parenthesis by the CENELEC certification; however, instruments provided are only required to have the approval/certification stated above. The instrument shall have a stainless-steel tag identifying the relevant approval or certification.

PART 2 PRODUCTS

2.01 FLOAT TYPE LEVEL SWITCHES

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 - 1. Contegra FS-90
 - 2. Flygt Model ENM 10.
 - 3. Endress+Hauser FTS20

4. Approved equal.
 - B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
 - C. General
 1. Provide sufficient lengths of Manufacturer's specialty cables for installation of power and signal conductors as provided with each instrument.
 - D. Type:
 1. The switch assembly shall be weighted and suspended on its own cable.
 - E. Function/Performance:
 1. Temperature Rating: 0 - 50 degrees C.
 2. Contact Rating: Up to 150V AC/DC and 1 amps AC, 1 amps DC.
 3. Contact Arrangement: Form C contact which is field selectable normally open or closed.
 - F. Physical:
 1. Contact: Sealed mercury free switch housed in a chemical-resistant polypropylene or Stainless-Steel casing.
 2. Switch shall have a rating for the area in which it is installed.
 3. Flexible Support Cable: Synthetic four wire cable, minimum 19 AWG wire.
 4. Specific Gravity: Match to fluid being measured.
 - G. Power Requirements
 1. None
 - H. Required Options/Accessories
 1. Provide flexible support cable of sufficient length to ensure no splice or connection is required in the wet well.
 2. Provide junction box rated for the area in which it is installed.
 3. Provide stainless steel supports/mounting accessories as required.
 - I. Installation
 1. Provide All Hardware from the manufacture for the installation as described and shown on the plans.
 2. Provide stainless steel wire ties for all cables within the wet well area or exposed to outdoor environments.
- 2.02 NON-CONTACT 2 WIRE RADAR LEVEL TRANSMITTERS (MEASURING RANGE > 66 FT)
- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Vega VEGAPULS 64
 2. Endress+Hauser
 3. No equal.
- B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
- C. General
1. Principle: To pulse W Band signals form the transducer toward the liquid and receive the echo measuring the time between sending and receiving the pulse signal and proportioning that to the measured liquid depth.
- D. Type:
1. 316 SS Antenna sensor
 2. Wetted parts 316L
 3. Horn Antenna
- E. Function Performance
1. Function: To sense variable liquid level.
 2. Voltage supply: 9.6 to 35 VDC
 3. Range Capability: 1 foot to 99 feet
 4. Process temperature: -196...200 °C (-320.8 to +392 °F)
 5. Ambient temperature: -40...80 °C (-40 to +176 °F)
 6. Process pressure: -1 to +25 bar
 7. Accuracy. ± 1 mm
 8. Frequency range: W-band, 80GHz
 9. Signal output: 4-20 mA/Hart – two-wire
 10. Beam Angle: $\geq 3^\circ$
 11. Shall have integral temperature compensation unit.
 12. Transmitter: Bluetooth wireless technology
 13. Cable length: As required.
 14. Process Connections Front Side: 1” NPT
 15. Ratings: Explosion proof, Class I, Group D, Division 1 or 2 installations.
 16. Warranty: 18 months minimum from the time of acceptance by the City.
- F. Physical
1. Mounting: flange mounted. The flange shall be 150 lb. RF, 316 SS.
 2. Antennae shall be shaped to optimize reading accuracy and desired location.

- G. Options/Accessories
 - 1. Provide stainless steel hardware.
- 2.03 NON-CONTACT 2-WIRE RADAR LEVEL TRANSMITTER (MEASURING RANGE < 66 FT)
 - A. Manufacturer:
 - 1. Vega: Vegapuls C23
 - 2. Endress+Hauser: Micropilot M FMR20.
 - 3. No equal.
 - B. Description: 2-wire loop powered non-contact radar level transmitter. The transducer full PVDF body to suit the chemical conditions of each tank.
 - C. Measuring ranges: 20m/ 66ft.
 - D. Process temperature: -40 to +80 °C (-40 to +176 °F)
 - E. Process pressure: -1 ... 3 bar
 - F. Accuracy: ± 2 mm
 - G. Frequency range: W-band, 80 GHz
 - H. Beam angle: 4°
 - I. Materials, wetted parts: PVDF
 - J. Ingress protection: IP66 / IP68
 - K. Power supply: 10.5 to 30Vdc, 2-wire
 - L. Current output: 2-wire; 4-20mA HART
 - M. Ambient temperature: -40 to +80 °C (-40 to +176 °F)
 - N. Transmitter: Bluetooth wireless technology
 - O. Cable length: As required.
 - P. Process Connections Front Side: 1" NPT
 - Q. Ratings: Explosion proof, Class I, Group D, Division 1 or 2 installations.
 - R. Warranty: 18 months minimum from the time of acceptance by the City.

PART 3 EXECUTION

3.01 INSTALLER'S QUALIFICATIONS

- A. The installer shall be specialized in installing this type of equipment with a minimum of 5 years documented experience.

3.02 EXAMINATION

- A. Examine installation area to ensure there is enough clearance to install the equipment.
- B. Verify that the equipment is ready to install.

- C. Verify field measurements are as instructed by the manufacturer.

3.03 INSTALLATION

- A. The Contractor shall install all equipment per the manufacturer's recommendations and Contract Drawings.
- B. All process connections shall be 316 stainless steel tubing, 3/8" minimum, unless otherwise shown on the Drawings. Fittings shall be of the compression type, 316 stainless steel.
- C. All conduit entries into the instruments shall use hubs of watertight, threaded aluminum, insulated throat, stainless steel grounding screw, as manufactured by T&B H150GRA Series, or equal.
- D. Install stainless steel instrument labels with instrument ID, secured with safety wire.
- E. All non-loop powered instrument transmitters shall have an approved disconnecting means for power mounted within reach of the transmitter.

3.04 RACEWAY SEALING

- A. Where raceways enter terminal boxes, junction boxes, or instrumentation equipment, all entrances shall be sealed with 3M 1000NS Watertight Sealant or approved equal.

3.05 FIELD QUALITY CONTROL

- A. Inspect installed equipment for anchoring, alignment, grounding, and physical damage.
- B. Check tightness of all accessible electrical connections. Minimum acceptable values shall be specified in the manufacturer's instructions.

3.06 FIELD ADJUSTING

- A. Adjust all equipment for proper range and field conditions, as described in the manufacturer's instructions.
- B. Any field adjustments, required for proper system operation, shall be included in the Final O&M.

3.07 FIELD TESTING

- A. Perform all electrical field tests recommended by the manufacturer.
- B. Test each interlock system for proper functioning.
- C. Test all control logic for proper operation.

3.08 CLEANING

- A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.09 EQUIPMENT PROTECTION AND RESTORATION

- A. Touch-up and restore damaged surfaces to factory finish, as approved by the manufacturer. If the damaged surface cannot be returned to factory specification, the surface shall be replaced.

3.10 MANUFACTURER'S CERTIFICATION

- A. A qualified factory-trained and certified representative shall certify in writing that the equipment has been installed, adjusted, including all settings as defined in the Contract Documents.
- B. The Contractor shall provide three (3) copies of the representative's certification.

END OF SECTION

SECTION 13400
CONTROL LOOP DESCRIPTIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This section includes instrumentation control loop descriptions.
- B. The design intent is that the control strategies for the process control and monitoring software are consistent with the City of Friendswood Design and Construction Standards and utilizing established City of Friendswood SCADA Team Software Engineering Standards.
- C. AESS shall incorporate all new electronic protective relays and power monitors as defined in Section 16197 Power Metering and Protective Relays into the existing Owners graphical user interface. The AESS shall additionally incorporate into the OIT/SCADA/HMI the list of data points as defined in the Contract documents.
- D. AESS shall utilize their system integrator development license to program the PLCs/OITs. No PLC or OIT software licenses shall be purchased for this project, nor will any be provided by the Owner.
- E. The AESS shall utilize their system integrator development license to program SCADA/HMI system. No SCADA/HMI software licenses shall be purchased for this project. The Owner will provide the AESS with access to the existing overall SCADA system, allowing for necessary modifications and the integration of the lift station as described in the project scope.
- F. All software engineering for all control panels, installed or modified under this project, will be provided by the AESS

1.02 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED WORK

- A. No references are made to any other section which may contain work related to any other section. The contract documents shall be taken as a whole with every section related to every other section as required to meet the requirements specified.
- B. The organization of the contract documents into specification divisions and sections is for organization of the documents themselves and does not relate to the division of suppliers or labor which the contractor may choose to employ in the execution of the contract. Where references are made to other sections and other divisions of the

specifications, the contractor shall provide such information or additional work as may be required in those references and include such information or work as may be specified.

1.04 SUBMITTALS

A. Submittal Process

1. Submittals shall be made in accordance with the requirements of Division 1, Section 13300 and as specified herein.
2. Submittals require information on related programming to be furnished under this specification and described in the related Sections listed in the related work paragraph above. Incomplete submittals not containing the required information on the related equipment will be returned un-reviewed.
3. Equipment specified in process, mechanical, or electrical equipment divisions, and supplied as an integral part of a process equipment manufacturer's package shall be submitted with the manufacturer's submittals, in those divisions.
4. The programming to interface the process, mechanical, or electrical equipment to the owner of the SCADA system shall be submitted as described herein and related specifications.

B. Submittal Content

1. Software Engineering Submittals: The AESS shall provide software engineering submittals for each process. The AESS will provide the Software Engineering Manuals in electronic form and at least 1 hard paper copy. The AESS manual will include:
 - a. A natural language process control narrative including software features and operation instructions. The narrative will reference the related process OIT/SCADA/HMI screen. Narratives shall be written to be understood by plant operators and maintenance personnel.
 - b. A full I/O list of all signals in the process identifying the device, network address, P&ID Tag, SCADA Tag description, data type, data range and engineering units.
 - c. The engineer may request additional information for complex nonstandard process control narratives.
2. Factory (Panel shop) Tests.
 - a. Submittals shall be made for factory tests as specified in Section 13302 Process Control System Testing. owner/engineer approval of required factory tests is required prior to shipment of the equipment.

3. Field Tests.
 - a. Submittals shall be made for field tests as specified herein including 13302.
4. Operation and Maintenance Manuals.
 - a. Operation and maintenance manuals include the Software Engineering Manual and shall include the following information:
 - 1) AESS's contact address and telephone number for service.
 - 2) Instruction books and/or leaflets
 - 3) Recommended system maintenance procedures.
 - 4) Record documents for the information required by the Submittals paragraph above.
 - 5) Final copies of all programs shall be included in electronic form and delivered directly to the Owner.

PART 2 PRODUCTS

2.01 LEVEL CONTROLLER

- A. Manufacturer and Model
 1. Motor Protection Electronics, LLC; Station Controller SC2000

PART 3 EXECUTION

3.01 LIFT STATION SYSTEM DESCRIPTION

- A. Lift Station control is based on programming and configuration of the PLC, OIT and the SCADA/HMI. PLC shall monitor the prominent level measurement system and control a output to start/stop pumps as specified in the Control Narratives and indicated on the Drawings.
- B. Level Measurement System: Equip pump station with a well level measurement system consisting of a submersible pressure transmitter and associated cable and installation mounting hardware to provide a 4-20 mA loop signal proportional to well level as indicated on the Drawings.
- C. Installation: Fabricate and install 316 stainless steel mounting hardware for level transmitter.
 1. Support Hardware: Provide mounting hardware as indicated in the Drawing.

2. Support cable: 1/8-inch stainless steel 316 cable to support 15-lbs PVC coated weight and float switches.
 3. Access manhole: Provide access manhole where the high-high/high level pumps override float switches can easily be removed, installed, and maintained.
 4. Access Manhole Submersible Level Transmitter: Provide where transmitter can easily be removed, installed, and maintained.
- D. OPERATOR INTERFACE TERMINAL (OIT) and SCADA/HMI
1. The AESS shall provide all the necessary programming and enter the required variable parameters to provide a complete functional and integrated system. The AESS shall customize the software to meet site-specific conditions. The system shall be fully tested to be operational prior to substantial completion. The AESS shall develop all required files and coordinate with the Owner to install and update the SCADA system.
- E. Communications: PLC shall be capable of full two-way cellular modem communications with the Owner's Central Control facility. Communications shall have the capability to transmit all station and pump status and alarms, well levels, PLC status and additional information indicated on the drawings, and shall receive pump start/stop set points, alarm set points and miscellaneous data via Owner SCADA software package and protocol. Provide necessary hardware and software required to implement the communications system as part of pump station control system work. Programming and modifications required at the Owner's Central Control facility will be performed by the AESS. AESS shall be responsible for coordinating and performing the communication testing verification of I/O via wireless system with Owner's operation staff.
- F. The PCSS shall coordinate with the owner, the AESS and with all the sub-systems suppliers and manufacturers, during bidding, construction, testing, installation, and start-up phases of the project. The coordination is to assure that the instruments and pump station are in compliance with the contract documents and that the necessary interface signals are provided as specified or required.
- G. Provide the owner's staff with all required training and operating procedures, at no extra cost to the owner. The training schedule shall be coordinated with the owner's representative.
- H. The calibration, testing, and start-up of all the instruments shall be done by the manufacturer's field technician in the presence of the owner and owner's representative. The contractor shall provide a list of all manufacturers whose technicians will perform this work. The contractor shall also provide a certified calibration report stating that each instrument shown or specified in the contract documents has been installed, tested, and calibrated per manufacturer's recommendations and per these contract documents. AESS shall perform unwitnessed I/O testing and functional testing before scheduling the witnessed SCADA test with the Owner and Engineer.

3.02 DEMONSTRATION

- A. Provide systems demonstration under provisions of Section 01770 - Closeout Procedures.
- B. The AESS shall demonstrate the operation and the programming of each process control system. Provide training as specified in Section 13306.
- C. System demonstration shall include the following:
 - 1. Complete verification of field wiring.
 - 2. Complete verification of system software.
 - 3. Demonstration of functionality of each discrete input and output by simulation of actual field device action.
 - 4. Demonstration of functionality of each analog input and output by actual variations in the process variable (e.g., well level, pump current reading, etc.).
 - 5. Complete demonstration of each alarm by simulation of actual field device action.
 - 6. Complete demonstration and verification (status/alarm points) of 2-way communication with Owner's Central Monitoring Facility.
 - 7. The AESS shall fully test the software and communication prior to providing software for the installation on the Onwer's SCADA system.
 - 8. Handouts and documentation shall be provided for all attendees at the demonstration site.

PART 4 PROCESS CONTROL NARRATIVES

- 4.01 For each lift station, the programming shall follow the process control narratives and descriptions as specified herein. SCADA integration and coordination of the various programs shall be the responsibility of the AESS. See Section 13300 for coordination requirements. The AESS shall provide a Software Engineering Manual detailing the control and monitoring features along with the operation and control narrative for each process. The Software Engineering Submittal shall include test procedures to be used for testing and verification once approved.

4.02 LIFT STATION CONTROL NARRATIVE

- A. The AESS shall program and configure lift station software for control and monitoring of the lift stations. This software includes the primary PLC, Local OIT, and the SCADA HMI. All software modifications shall comply with current Owner's SCADA standards, including the use of function blocks, signal naming and signal descriptions. The SCADA software application shall implement all specified requirements by engineer of the record including the level control start and stop pump set points (known as lead-lag setpoints).
- B. The summary of control narrative consists of prominent control via primary PLC, and a backup float system:
 - 1. The lift station is a fully automated system. The operator has access to the following controls on the control panel.
 - a. Pump HOA Switch: Auto = Normal operation pump runs as needed, off = Out of service, Hand = Pump runs continuously.
 - b. Reset Switch: Resets latched pump faults, Resets the PLC pump control and resets back up to primary PLC mode.
 - c. The local OIT and SCADA HMI are used for monitoring the lift station only (no control via SCADA screen).
 - 2. Primary PLC Control
 - a. Software application monitors level readings and start/stop pumps automatically per defined lead and lag set points as recommended by Engineer of Record. Refer mechanical drawings for setpoints.
 - b. Software application is configured to record run status to maintain totalized run time for each pump.
 - c. Software application monitors alarm status signals wired to PLC input and transfer control command to the next pump upon any trip on overload, high temperature, and/or seal failure. When a lead pump is called to run but trips to any alarm condition, then the next pump will be called to run as long as the level setpoint is within required level range (the current application performs this function). When a pump is taken out of service due to alarm condition (lockout via relay interlock), the software application will call for the next pump to run after the pump fails to start.
 - d. Fail to start, when a pump is called to run but a run signal is not responded as an input to PLC (pump run status) within a predefined time (default in 5 second), the start command will be transferred to the next available pump.

- e. Software application monitors under voltage / phase failure alarm and takes all pumps out of service upon this condition.
 - f. High level, low level, or PLC fault shall transfer control to the backup float.
 - g. Reset to primary mode shall only be provided by control panel reset switch or power cycle to control panel.
 - h. When the HOA switch is not in auto position, the software application will skip the pump from the call sequence (the current application performs this function).
 - i. When the HOA switch is in hand position, the software application takes no control action on the pump control. The only mode of protection will be the overload trip. High-temperature and seal failures are bypassed.
 - j. When power is restored to the station, the control system operation shall revert to the state of the primary PLC control. The software application shall retain the last working operation state. The control will prevent surging by turning on pumps based on configured timers and only the number of pumps required to cause the level to start dropping.
 - k. When a lead pump runs continuously for more than 8 hours (configurable value presently set for 8 hours as default), the software application shall rotate the pump and transfer the lead to the next pump. This function will not apply when more than one pump is running.
 - l. Software application shall be configured to accommodate current and future pump quantity requirements.
 - m. All status and alarms are displayed on the SCADA HMI and local panel OIT.
 - n. The software application is configured to provide First-On First-Off alternation to equalize pump run times.
3. Backup Float Controls
- a. In case of PLC failure or level sensor malfunction or high-level condition, float switches act as a backup control system. Float switches are set at similar levels to ensure redundancy.
 - b. An alternator mechanism ensures that after each full cycle, the role of the Lead pump is alternated among the pumps. If the PLC is down or a level sensor malfunction or high-level condition, the float system's alternator will switch the pump roles for the next cycle, ensuring even wear of pumps.

4.03 STANDARD LIFT STATION SOFTWARE FEATURE LIST

- A. The lift station software is an integrated package including the primary PLC, local OIT, and SCADA/HMI. The software provides lift station, control, monitoring, alarming, data logging and pump performance calculation. The software application is in use for all operating lift stations and accommodates all the variations between them. All the lift stations are constantly monitored using the standard SCADA interface at the Owner's SCADA Control Center.
- B. The software application control meets the TCEQ Design Criteria §217.60. Lift Station Pump Control:
 - 1. Pump control is automatic based on the well level and includes surge prevention to the collection system and wastewater treatment facilities.
 - 2. The surge prevention shall be in effect after power interruptions by systematically starting only the number of pumps required to accommodate the influent and cause the level to start decreasing. The software shall be configured with time delays between starting and stopping pumps.
 - 3. The maximum number pumps allowed to run shall be configurable as specified to further aid in surge control.
 - 4. The software application shall monitor float switches as alarms in primary mode. The software application shall not use the float switches in the control of pumps.
 - 5. The software application shall be configured to use the specified level lead-lag pump control set points and shall alternate the lead pump position and add lag pumps as required to maintain the well level. The consulting engineer has determined these set points based on the TCEQ Design Guidelines for Minimum Pump Cycle Times considering the peak flow, well design and pump horsepower.
 - 6. The software application shall be configured to use the specified level set points for:
 - a. Low-Low well level shall generate an alarm immediately shut off all pumps.
 - b. High well level shall generate an alarm and pump control shall continue adding lag pumps if available.
 - 7. The software application shall support the TCEQ Design Guidelines pertaining to maintaining the wet well level below the inlet elevation with the software programming and configuration of utilizing the specified pump control lead-lag set points. The consulting engineer may specify the same lead-lag set points for some or all pumps.

8. As defined in the TCEQ Design Guidelines the software application shall be configured to generate lift station alarms on the main SCADA screens for: power outages, pump failures, high well levels and Loss of lift station communications.
- C. The software application shall continuously monitor level transmitters and utilize the signal for control. When the level transmitter is out of operating range, it shall not be used for control. When both transmitters are out of range, control shall roll over to back up float.
- D. The software application shall switch off any continuously running lead pump for a predefined number of hours (presently set as a default for 8 hours but adjustable up to 24 hours).
- E. The software application shall include the standard pump performance monitor calculating the pump's flow capacity.
- F. The float signals are monitored on the primary PLC and the OIT/SCADA/HMI.
- G. Pump performance monitoring is implemented using continuous pump drawing down measurements and calculations. Non-performing pumps are easily identified on the WWTP influent flow HMI screens.
- H. Lift station influent and effluent flow monitoring and trending is accomplished using pump performance calculations, this feature is intended to detect pump and check valve performance issues.
- I. Additional SCADA monitoring includes pump motor currents, HOA status, lift station intrusion detection, pump control details and main PLC communication status.
- J. Lift station static details are recorded on the SCADA HMI lift station screens including associated WWTP, well dimensions, elevations, critical levels, electric company meter number, site voltage, pump horsepower and current.
- K. The local OIT is configured to display the same information as the HMI distributed across multiple screens to accommodate the reduced screen size.

4.04 STANDARD LIFT STATION CONTROL AND MONITORING

- A. Alarming and Faulting
 1. Alarms are displayed and logged on to the SCADA HMI and the local OIT.
 2. Under voltage – On an under-voltage alarm, the primary PLC will prevent pumps from running in Auto until power is restored. This also resets the pump control algorithm.

3. High Level – When the well level reaches the high-level alarm set-point, as determined by the configuration, the level alarm indication is set and latched. A flasher, beacon alarm, will be generated from the PLC until the level drops below the predetermined alarm set point. To reset, the reset switch is pressed, and the alarm will be cleared.
4. Low Well Level Lockout – All pump cutoff. If pumps reach this level while in PLC controls, this is an overriding shutoff that will cut off all pumps instantly.
5. The software application shall monitor alarms and transfer control on any alarm fault. These faults can include the seal failure, motor overload and pump over temperature. The alarms are latched via relay interlock to shut pump off and require a local reset.

END OF SECTION

SECTION 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Basic requirements specifically applicable to the work of Division 16 - Electrical Requirements.
- B. The Contractor shall furnish all permits, equipment, materials, and labor for assembly and installation plus check out and start-up of electrical systems as shown on the Contract Drawings and stipulated in the Contract Specifications.

1.02 REFERENCES

- A. As a minimum requirement, the electrical system shall be constructed in accordance with:
 - 1. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), No. 70 - National Electrical Code (NEC). The contractor shall provide all electrical work/installations based on the latest addition of NEC.
 - 2. City of Friendswood Construction Code.
 - 3. Other applicable Codes and Standards as referenced in other Specification sections.
- B. Comply with local, county, state, and federal regulations and codes in effect as of the date of purchase.
- C. Equipment of foreign manufacturers must meet U.S. codes and standards.
- D. Equipment and materials shall conform to requirements of these specifications and to the criteria provided in data sheets for the project.

1.03 QUALITY ASSURANCE

- A. Product Conformance Certificate and Quality Assurance Release. Submit an overall conformance certificate for electrical components signed by the person responsible for product quality.
- B. Specifically identify the purchased material or equipment by project name and location, purchase order number, supplements, and item number where applicable, including materials and services provided by others. Indicate that all requirements have been met and identify any approved deviations.
- C. Field Inspection
 - 1. Electrical work shall be inspected and approved by the local municipal code inspector, the wastewater inspectors, and the Project Manager prior to starting the 7-day test or scheduling training.
 - 2. Contractor shall give a minimum of two day's notice to the Inspector that the installation is ready for inspection and two days' notice to the Project Manager.

3. Concealed work shall be inspected and approved by code inspectors and wastewater inspectors before it is covered:
 - a. Conduit with stub-ups, underground in duct banks before concrete is poured.
 - b. Conduit in slabs, walls and ceilings, complete with boxes.
4. Electrical equipment and materials shall be inspected upon arrival by the Project Manager for compliance with specifications.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Major electrical equipment shall be from the same supplier, when possible. This shall apply to Main Breaker, MCC, Panelboard, and Transformer.

2.02 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. Components must be of the most recent generation in current manufacture.

2.03 FACTORY INSPECTION

- A. Provide free access with prior notice for the City Engineer at all times to the shop where the material or equipment is being fabricated or tested. Provide reasonable facilities for inspection, witnessing tests, and examining records. Give 7-days notice prior to starting tests scheduled for factory inspection.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify dimensions and ratings of equipment and materials to ensure proper fit and performance.

3.02 INSTALLATION

- A. Install equipment and materials in accordance with the Contract Drawings and manufacturer's written instructions. If field conditions necessitate changes in electrical installation, obtain approval from the City Engineer.
- B. Conductor Voltage drop shall not exceed 2 percent for feeders and 3 percent for branch circuits.

3.03 DEMONSTRATION

- A. Test the electrical system to specification requirements and demonstrate correct installation and operation of equipment. O & M Manual shall be furnished prior to testing for reference during testing and corrections for final O & M.
- B. Before performing 7-day test, demonstrate the system to the wastewater inspectors and the Project Manager. Show the system to be fully operational. All alarms,

safeties, and communication points to central and locally must operate in both full-automatic and back-up modes. Use fresh water in the test medium.

- C. Operate the system continuously for a period of 7 days in full automatic, without failure, to qualify as acceptable. "Failure" is considered any problem that requires correction by process control instructions, maintenance personnel, such as: high or low water level, any motor alarm, power failure, phase failure, communication failure, PLC failure, process control software failure, requiring rewriting or transducer failure. This would exclude conditions not under the control of Contractor, such as: evident lightning strikes, 25-year rains, local power utility power failure longer than the specified duration of service. Failures due to uncontrollable situations would allow the 7-day test to continue, as soon as test conditions are restored and the City Engineer is notified.
- D. The existing lift station shall remain in service during tests.

END OF SECTION

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SECTION 16045

ELECTRICAL SUPPORT HARDWARE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install electrical support hardware, as shown on the Drawings and as specified herein.
- B. Hardware shall include anchor systems, adhesive anchor systems, metal framing systems, and other electrical support systems, as shown on the Drawings and specified herein.

1.02 RELATED WORK

- A. Refer to Section 16000 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

- A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 16000, the following:
 - 1. Manufacturers' names and product designation or catalog numbers of all materials specified.
 - 2. Cut sheets for each individual item shall be submitted.
 - 3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.
- B. The submittal information, for anchor systems, shall contain manufacturer's specifications and technical data including:
 - 1. Acceptable base material conditions (i.e., cracked, un-cracked concrete)
 - 2. Acceptable drilling methods
 - 3. Acceptable bore hole conditions (dry, water saturated, water filled, under water)
 - 4. Manufacturer's installation instructions including bore hole cleaning procedures and adhesive injection.
 - 5. Cure and gel timetables
 - 6. Temperature ranges (storage, installation and in-service).
- C. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will also be returned without review.

1.04 REFERENCE CODES AND STANDARDS

- A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):
 - 1. NFPA 70 National Electrical Code (NEC)
 - 2. NFPA 70E Standard for Electrical Safety in the Workplace
 - 3. ASTM E 488-96 (2003); Standard Test Method for Strength of Anchors in Concrete and Masonry Elements, ASTM International.
 - 4. ASTM E 1512-93, Standard Test Methods for Testing Bond Performance of Adhesive-Bonded Anchors, ASTM International
 - 5. AC308; Acceptance Criteria for Post-Installed Anchors in Concrete Elements, Latest revision.
 - 6. SAE 316 Stainless Steel Grades
- B. All equipment components and completed assemblies having a UL standard specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.05 QUALITY ASSURANCE

- A. The manufacturer of these materials shall have produced similar electrical materials and equipment for a minimum period of five years. When requested by the Owner/Engineer, a list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

- A. Prior to jobsite delivery, all submittal requirements must be complete, and an approved copy of all such submittals shall be available to the Owner/Engineer prior to delivery of the equipment. Delivery of equipment not completely constructed, onsite factory work, or failed factory tests will not be permitted.
- B. Materials shall be handled and stored in accordance with manufacturer's instructions.
- C. Adhesive Anchor Systems.
 - 1. Deliver materials undamaged in Manufacturer's clearly labeled, unopened containers, identified with brand, type, and ICC-ES Evaluation Report number.
 - 2. Coordinate delivery of materials with scheduled installation date, minimizing storage time at jobsite.
 - 3. Store materials under cover and protect from weather and damage in compliance with Manufacturer's requirements, including temperature restrictions.
 - 4. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
 - 5. Do not use damaged or expired materials.

6. Storage restrictions (temperature range) and expiration date must be supplied with product

D. Metal Framing Systems

1. Material shall be new and unused, with no signs of damage from handling.

1.07 WARRANTY

- A. Provide warranties, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

1.08 MEASUREMENTS AND PAYMENT

- A. Refer to Section 16000.

PART 2 PRODUCTS

2.01 ANCHORING SYSTEMS

A. Acceptable Manufacturers

1. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 - a. HILTI Kwik Bolt 3
 - b. Approved equal.
2. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

B. Product Description

1. Torque controlled expansion anchor consisting of anchor body, expansion element (wedges), washer and nut. Anchor shall be used for anchor sizes less than 3/8 inch.
2. All parts shall be 316 stainless steel materials conforming to SAE 316.
3. UL 203 Rated.

2.02 ADHESIVE ANCHORING SYSTEMS

A. Acceptable Manufacturers

1. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 - a. HILTI HIT-Z with HIT-HY 200 MAX.

- b. Approved equal.
- c. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions.
Manufacturers listed above are not relieved from meeting these specifications in their entirety.

B. Product Description

- 1. Anchor body with helical cone shaped thread on the embedded end and standard threads on the exposed end, with washer and nut, inserted into Injection adhesive. Anchor shall be used for anchor sizes 3/8 inch and larger.
- 2. All parts shall be 316 stainless steel materials conforming to SAE 316 standards.

2.03 STRUT SUPPORT SYSTEMS

A. Acceptable Manufacturers

- 1. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 - a. Tyco Unistrut
 - b. Eaton
 - c. Thomas & Betts Super-Strut
 - d. Approved equal.
- 2. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions.
Manufacturers listed above are not relieved from meeting these specifications in their entirety.

B. Product Description

- 1. Metal framing system for use in the mounting or support of electrical systems, panels, and enclosures, and including lighting fixture supports, trapeze hangers and conduit supports.
- 2. Components shall consist of telescoping channels, slotted back-to-back channels, end clamps all threads and conduit clamps.
- 3. Minimum sizes shall be 13/16-inch through 3-1/4 inch.
- 4. Components shall be assembled by means of flat plate fittings, 90-degree angle fittings, braces, clevis fittings, U-fittings, Z-fittings, Wing-fittings, Post Bases, channel nuts, washers, etc.
- 5. Field welding of components will not be permitted.
- 6. Unless otherwise specified or shown on the Drawings, all parts shall be 316 stainless steel material conforming to SAE 316.
- 7. Framing systems for chlorine and ammonia rooms shall be manufactured of structural fiberglass.

2.04 STAINLESS TIES

A. Acceptable Manufacturers

1. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 - a. Panduit
 - b. Phoenix Contact
 - c. Gardner Bender
 - d. Approved equal.
2. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

B. Product Description

1. Cable Ties for securing and supporting of flexible raceway and conductors.
2. Self-locking mechanism.
3. Material shall be 304 Stainless Steel unless otherwise directed as shown on the drawings.

C. Locations for Use

1. Cable Ties of stainless steel to be used in wet environments, where exposed to process, or when exposed to sunlight
2. Self-locking mechanism.

PART 3 EXECUTION

3.01 GENERAL

- A. Install all equipment strictly in accordance with the manufacturer's instructions and the Contract Drawings.
- B. The locations of devices are shown as general on the Drawings and may be varied within reasonable limits as to avoid any piping or other obstruction without change in the Contract Price or Schedule, subject to the approval of the Owner and Engineer. Coordinate the installation of the devices for piping and equipment clearance.
- C. No electrical equipment or raceways shall be attached to or supported from, sheet metal walls.
- D. Install required safety labels.
- E. Electrical support channel shall be used to construct support assemblies as shown on the drawings. Horizontal braces attached to concrete or CMU walls or structural building steel are permitted if the space between the back of the support structures and the attachment points are too small to permit a walk space. No attachments to

sheet metal are permitted as specified above. Incorporate additional channel materials and/or provide assemblies of double channel with enough vertical and horizontal members to form a rigid structure even if such additional materials or the use of double channel materials are not shown or specified. Support structures shall be rigid without the use of channels to form angle supports between the back or front of the assembly and the ground. Angle supports are strictly prohibited because they provide tripping hazards. Outdoor support structures shall be able to support the equipment with the structural strength to withstand wind gusts up to 90 mph without damage.

3.02 FIELD QUALITY CONTROL

- A. Inspect installed equipment for anchoring, alignment, grounding and physical damage.
- B. Check tightness of all accessible electrical connections. Minimum acceptable values are specified in manufacturer's instructions.

3.03 POST INSTALLED ANCHOR SYSTEMS

- A. Prior to installation of the anchor systems, the hole shall be clean and dry in accordance with the manufacturer's instructions.

3.04 CLEANING

- A. Remove all rubbish and debris from inside and around the installation. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

END OF SECTION

SECTION 16060
ELECTRICAL DEMOLITION

PART 1 GENERAL

1.01 SUMMARY

- A. Electrical Demolition.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. This item will be measured and paid for as a lump sum for each lift station site.
2. Payment will be full compensation for all labor, equipment, materials and supervision for the demolition, cleanup and other related work necessary for construction as shown on the drawings and specified herein.
3. Refer to Section 01270 – Measurement and Payment for unit price procedures.

1.03 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 Wiring
 2. City of Friendswood Electrical Code.

1.04 SUBMITTALS

- A. Annotate existing drawings to sequence the demolition of systems, equipment removal and temporary hook-ups.
- B. Schedule with Project Manager for required shut-downs to accommodate system demolition and installation of temporary facilities.

1.05 QUALITY ASSURANCE

- A. Verify field measurements and circuiting arrangements as are 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 discrepancies to City Engineer before disturbing existing installation.
- D. By beginning of demolition, installer shall accept 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 City all items and systems in good operating condition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

2.02 DESIGN AND CONSTRUCTION

- A. The temporary electrical wiring and facilities shall be designed and constructed in strict compliance with NEC - Article No. 590 and the City of Friendswood Electrical Code.

PART 3 EXECUTION

3.01 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Coordinate utility service outages with utility company to provide continuous service to operating equipment.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, notify City of Friendswood Utility Operations, and get approval. Use personnel experience in such operations.
- D. Provide notification at least one week before partially or completely disabling system. Minimize outage duration.
- E. Adding Load to Existing Electrical System: Perform a load analysis to assure that the existing power distribution system (MCC, service, conductors, panel, breakers, feeders, branch circuits, etc.) is not overloaded if additional load is added to existing equipment.
- F. Existing electrical conduit and wire may not be reused to feed new equipment except by written authorization from the City of Friendswood.

3.02 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. This includes all associated support and anchoring systems. Cut conduit flush with walls and floors, and patch surfaces.
- D. 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.
- E. Disconnect and remove abandoned panelboards and distribution equipment.
- F. Disconnect and remove electrical wire, conduits, devices, and equipment serving utilization equipment that has been removed.

- G. Repair adjacent construction and finishes damaged during demolition and extension work. Repairs to include matching material type and color.
- H. Maintain access to existing installations which remain active. Modify installation or provide access panel as appropriate. Cut abandon conduits in floors or slabs flush to surface, fill with concrete and patch to match surface type and color.
- I. Extend existing installations using the materials and methods specified for new work.

3.03 DISPOSAL AND SALVAGE

- A. Salvaged electrical and instrumentation equipment as well as wiring of size four and larger will be removed from existing facilities for City's reuse.
- B. Material and equipment which can be reused or salvaged remains the property of the City of Friendswood. Equipment to be retained by the City of Friendswood shall be delivered to a specified location by the Contractor.
- C. Materials and equipment which cannot be reused or salvaged will be removed and disposed of by the Contractor.

3.04 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are 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 arrangement.

3.05 INSTALLATION

- A. Install relocated materials and equipment under the provisions of Section 02220 - Demolition.
- B. Electrical installations and materials shall conform to the current issue of the following standard and codes: American National Standards Institute/National Fire Protection Association (ANSI/NFPA), No. 70 - National Electrical Code (NEC), City of Friendswood Electrical Code, and material and workmanship.
- C. All material shall be free of defects and in safe working condition which will meet electrical classification and functional requirements.
- D. Testing shall be made during the course of construction or at the completion of the job. These tests shall be made by the electrical contractor. The contractor shall furnish all test equipment.
- E. The job will not be complete until work has been inspected and trial startup has been successfully completed.

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SECTION 16105
POWER SYSTEM STUDY

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide a Power System Study for the electrical power system, including a Short Circuit Study, Coordination Study, Arc Flash Hazard Study, and additional studies as listed below.
- B. The electrical power system shall include the utility company's transformer, the Owner's entire power distribution system, all existing and/or new system components, including any on-site standby generation. The short circuit and coordination study reports shall provide an evaluation of the electrical power systems and the model numbers and settings of the protective relays or devices and metering or motor monitoring devices for setting by the Contractor. The Study shall include settings for all motor protective relays and electric system monitoring devices.
- C. The Study shall model all electrical equipment down to and including 480-Volt utilization equipment. Additional equipment may be required to be modeled. Refer to latest standards of IEEE 1584.
- D. Motor Starting Voltage Drop Study: The Study shall include all motors modeled individually, including disconnect switches, if present.
- E. Obtain and provide all pertinent data necessary for the successful completion of the Power System Studies, including information on all existing and/or new equipment and wiring pertinent to the Study. This includes all cable and raceway data, data for existing and/or new motors, data from all existing and/or new switchgear, motor control centers, panel boards, and separately mounted fuses, starters, and circuit breakers. Obtain all existing or new protective device information to include all present settings. Obtain any needed data or information from Contract Documents, various suppliers, the Electric Utility and from conducting his own field investigations. If during field investigations conflicts between the Contract Documents and the field conditions are encountered, immediately notify the Owner/Engineer for a resolution to the conflict. Copies of the data obtained, shall be organized, and submitted to the Owner/Engineer at the same time of transmittal to the Study Engineer, to show that all the requested data gathering work has been completed.

1.02 RELATED WORK

- A. Refer to Division 16000 and the Contract Drawings, for related work and electrical coordination requirements.
- B. Provide all the information required, to the Study Engineer in a timely manner.

1.03 SUBMITTALS

- A. Submit to the Owner/Engineer, shall be made in accordance with Division 1 and Section 16000 the following:
 - 1. No later than four weeks after Contract Award, provide a submittal of the name and qualifications of the Study Engineer, for approval.
 - 2. No submittals required under this section will be accepted until this requirement is met, and if submitted will be returned without review.
- B. Provide the following additional submittals:
 - 1. Preliminary Study: The first submittal shall consist only of the Short Circuit Study results and equipment evaluation, based upon sound engineering reasonable assumptions, where known values are not available. This submittal shall be used by the Study Engineer to ascertain the short circuit current rating of the related equipment. This submittal shall be made and approved prior to any shop drawing submittal being reviewed for electrical equipment for which the results of this preliminary study are required. The submittal and approval of the Preliminary Study is a critical milestone in the Construction Schedule. Failure to submit an acceptable study in a timely manner may delay the Project Schedule. No exceptions will be made for the specified sequence of the submittal of the Study prior to the submittal of shop drawings, and any delays caused by a late submittal of the Study will not be a cause for the Engineer / Owner to allow any extension of the Contract Time or Contract Price.
 - 2. Final Study: The final submittal shall be the Final Study and shall include all items listed under "Scope of Work" in this Section. No electrical equipment for which the results of the final study are required, shall be energized until such results have been reviewed and approved by the Engineer / Owner, and applied to such electrical equipment, and certified as Settings Complete by the manufacturer's field representative. This submittal is required to include a PDF of the study and a copy of the SKM raw data input files as specified in Section 16000.
- C. Upon completion of the studies, submit the studies for approval to the Owner/Engineer. The study submittal shall include all the input and output data files in electronic format for use directly with the specified study software. The Study shall include an actual size sample of an Arc Flash and Shock Hazard label with typical information shown. Allow not less than three calendar weeks for review of the both the Preliminary and Final Studies by the Owner/Engineer. The submittal shall not contain unresolved questions, conflicts, or selective device coordination conflicts. A submittal containing such questions or conflicts will be returned unreviewed and shall not be resubmitted until such questions or conflicts have been resolved. Delays in the Construction Schedule due to the submittal of unacceptable Power System Studies will not be a cause for the Engineer / Owner to approve any changes in the Contract Time or Contract Price.
- D. The completed, sealed, and signed studies, with all known issues resolved, shall be submitted to the Owner/Engineer for approval, not less than 30 days prior to site

delivery of any equipment containing protective devices requiring selections and settings for certification by the manufacturer. Final copies shall be in electronic form (Adobe PDF formatted files). SKM data files, including any custom forms, labels, formats, and libraries, shall be provided at the same time in electronic format as specified herein. All individual arc flash labels, ready for installation, shall be provided with this submittal.

- E. Submit for approval, a manufacturer's conducted training agenda for all training specified herein. Training agenda shall not be submitted until final approval of the Operation and Maintenance Manual

1.04 REFERENCE CODES AND STANDARDS

- A. The specified studies shall be in accordance with the latest versions of the following codes and standards.
 - 1. IEEE Standard 1584 – IEEE Guide for Performing Arc-Flash Hazard Calculations, Including Amendment 1584a.
 - 2. NFPA-70E - Standard for Electrical Safety Requirements for Employee Workplaces.
 - 3. ANSI/NFPA 70 – National Electrical Code
- B. The studies shall be performed using SKM Power Tools Electrical Engineering Analysis Software for Windows.

1.05 QUALITY ASSURANCE

- A. The studies shall be performed by an Electrical Engineering Services firm, who is regularly engaged in power system studies. The studies shall be performed by a Licensed Professional Electrical Engineer (PE) in the regular employment of the firm with proficiency in electrical power systems engineering and shall seal and sign the final completed power system studies. The Study Engineer shall be licensed to practice engineering in the State of Texas.
- B. The PE shall comply with the State PE Law in the submittal of the Preliminary and Final Studies. The Preliminary Study shall bear the name and registration number of the PE who will be sealing the work along with the statement acceptable to the State PE Board which indicates the work is "Preliminary, Not for Construction" and is "Issued for Review". The final report shall bear the Engineer's Seal, Registration Number, Original Signature and Date in accordance with the State PE Laws.
- C. Computer Model Revision Control
 - 1. When Contract Documents show work to be performed on an existing facility, Study Engineer shall first confirm if an existing study has been performed and whether an existing base model computer file is available.
 - 2. If available, ensure the following steps are taken to maintain a single base model computer file for facility.
 - a. The Study Engineer shall check out and receive from the Owner, prior to executing the Study, the base model computer file to be used with the SKM

System Analysis computer program. The Study Engineer shall be responsible for the return of this computer file to Owner upon completion of the Study and acceptance of the Report by the Owner/Engineer. Field verify all existing protective equipment, protective device settings and conductors shown in the model which are in series with the new equipment all the way from the Utility and or Generator power sources to the connection point of the new equipment. Field verify the name plate data on all existing motors connected to the same bus or any upstream bus which is in series with the new equipment. The same criterion applies to all existing equipment modified under this Contract. Notify the Owner/Engineer of any discrepancies discovered which exist between the Owner's power system model and existing field conditions prior to the submittal of any Studies for review.

- b. The Study Engineer shall incorporate the Study conducted for this Contract into the overall base model computer file. The updated file shall be returned to the Engineer for review along with the Report Submittal. It is unacceptable to add the branches of the new equipment provided under this Contract in a stand-alone or separated configuration from the overall power system and adding in the available fault current at the point of attachment. All revisions and the addition of all new equipment shall be tied into the existing power system model by the Study Engineer.
 - c. The Study Engineer shall forward the updated base model computer files to the Owner with the submittal of the Preliminary Study for the Engineer to check, and again the final model shall be submitted upon approval of the Final Report Submittal. This shall constitute checking this file back in to the Owner. Should the Report Submittal be rejected for any reason, the base model computer file shall be checked out again and returned to the Study Engineer for further use.
3. When no existing base model computer file is available:
- a. Field verify all existing protective equipment, protective device settings and conductors which are in series with the new equipment all the way from the Utility and or Generator power sources to the connection point of the new equipment. Field verify the name plate data on all existing motors connected to the same bus or any upstream bus which is in series with the new equipment. The same criterion applies to all existing equipment modified under this Contract.
 - b. For limited scope projects, it is acceptable to add the branches of the new equipment provided under this Contract in a stand-alone or separated configuration from the overall power system and adding in the available fault current at the point of attachment.
 - c. The Study Engineer shall forward the base model computer files to the Owner with the submittal of the Preliminary Study for the Engineer to check, and again the final model shall be submitted upon approval of the Final Report Submittal. Should the Report Submittal be rejected for any reason, the base model computer file shall be updated a resubmitted with revised Report.

1.06 SCHEDULE OF WORK

- A. The selection of the Study Engineer shall be submitted to the Owner/Engineer for approval in a timely manner, in accordance with the time specified. The Study shall be completed and submitted in the phases as specified above.
- B. The completed studies, with all known issues resolved, shall be submitted to the Owner/Engineer for approval, as specified above.

1.07 MEASUREMENT AND PAYMENT

- A. Refer to Section 16000.

PART 2 STUDIES

2.01 ELECTRICAL ENGINEERING SERVICES FIRMS

- A. The work experience resume of the Study Engineers who will be doing the work and the Professional Engineer who will be sealing the Final Study shall be submitted along with his / her PE registration number in the State where the equipment is to be installed. Subject to compliance with the Contract Documents, the following services firms are acceptable:
 - 1. Eaton Engineering Services
 - 2. ABB Engineering Services
 - 3. Schneider Electric Engineering Services
 - 4. Rockwell Automation Engineering Services
 - 5. Approved equal

2.02 SHORT CIRCUIT AND COORDINATION STUDY

- A. Provide a complete short circuit study. Include three phase, phase-to-ground calculations, and X/R ratios. Provide an equipment interrupting or withstand evaluation based on the actual equipment and model numbers provided on this project including any existing equipment modified in any way under this project. Field verify the name plate data of all existing transformers, protective device equipment and the size and length of any existing conductors in series with the new or modified equipment in the Contract. Conductor lengths in concealed conduit shall be estimated to the best of the Contractor's ability from field observations and any available existing conformed to construction record drawings. Generic devices or values are not acceptable. Normal system operating method, alternate operation, and operations that could result in maximum fault conditions, shall be thoroughly addressed in the study. Provide single phase to ground and three-phase to ground fault information. The study shall assume all motors are operating at rated voltage with the exception that motors, clearly identified as "standby," shall not be included. Electrical equipment bus impedances shall be assumed as zero. Short circuit momentary duties and interrupting duties shall be calculated based on maximum available fault current at the switchgear busses, switchboard busses, motor control centers and panelboards. The study shall be performed using actual available short

circuit currents as obtained from the Electric Utility. An assumption of infinite bus for the purposes of the Preliminary or Final study is not acceptable.

- B. Provide an equipment evaluation study to determine the adequacy of the fault bracing of all bus from the panel board level up to the main switchgear or protective device. Include circuit breakers, controllers, surge arresters, busway, switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the available fault currents.
- C. Provide a protective device coordination study. The study shall include all electrical equipment provided under this Contract, including Control Panels containing power and protection equipment lighting panels and power panels. The Study shall include any upstream or downstream equipment that has an impact on the Coordination Study. The study shall show transformer damage curves, cable short circuit-withstand curves and motor starting curves. The phase overcurrent and ground fault protection shall be included, as well as settings for all other adjustable protective devices. All motor monitoring relays and protective or monitoring devices that are a part of a supplier's equipment, such as soft starters or adjustable frequency drives shall be included. Include the last protective device in the Electric Utilities' system feeding each facility being considered. Include all medium voltage switchgear, distribution switchboards, motor control centers and 480 Volt panelboard main circuit breakers. Complete the short circuit study down to the main breaker or largest feeder on all on all 480 Volt panelboards. Panelboard branch circuit devices need not be considered. The phase overcurrent and ground-fault protection shall be included, as well as settings for all other adjustable protective devices. All motor monitoring relays and protective or monitoring devices that are a part of a supplier's equipment, such as soft starters or adjustable frequency drives, shall be included. Include the last protective device in the Electric Utilities system feeding each facility being considered.
- D. Selective device coordination is required between protective devices in equipment specified in each Section of the Electrical Specifications, and between each piece of electrical equipment supplied for this project. Include settings for the protective devices in existing equipment feeding any piece of new equipment. If the Study Engineer, during his work, determines that selective coordination cannot be obtained in or between pieces of existing and/or new equipment as specified, the Owner/Engineer shall immediately be notified, Provide the supporting information to the Owner/Engineer for resolution of the problem.
- E. As a minimum, each short circuit study shall include the following:
 - 1. One-Line Diagram: The presentation of the One Line Diagram shall be on one or more 22 x 34-inch drawings with match lines if on multiple sheets, using font sizes which are easily readable. Include the following information and activities listed below:
 - a. Location and function of each protective device in the system, such as relays, direct-acting trips, fuses, etc.

- b. Type designation, current rating, range or adjustment, manufacturer's style and catalog number for all protective devices.
 - c. Power and voltage ratings, impedance, primary and secondary connections (Delta, Wye, Grounded Wye, Zig-Zag, etc.) of all transformers. Use the ratings of the actual transformers being provided where available. The Final Study shall use the name plate information on the transformers provided. Use the actual name plate information on all existing transformers. Generic transformer data on new or existing transformers are not acceptable.
 - d. The type, manufacturer, and ratio of all instrument transformers energizing each relay shall be included on both existing and/or new instrument transformers. Field verify this information on all existing protective devices which are in series with the new equipment provided under this Contract.
 - e. Nameplate ratings of all motors and generators with their sub transient reactance. Field verify the name plate information of all existing generator providing power to the new equipment, and field verify the name plate motor information on all motors connected to the bus of existing equipment which is in series with the new equipment.
 - f. Sources of short circuit currents such as utility ties, generators, synchronous motors, and induction motors. Provide short circuit studies using each source of power separately. The study shall determine if there is sufficient short circuit current to adequately cause interruption of a protective device using the weaker power source (typically local generation) and shall determine if the equipment can safely interrupt the fault if the greater power source is connected. Additional short circuit calculations shall include emergency as well as normal switching conditions as well as normal and emergency power sources described here in.
 - g. All significant circuit elements such as transformers, cables, breakers, fuses, reactors, etc. shall be included.
 - h. The time-current setting of existing adjustable relays and direct-acting trips, if applicable. Field verify the information as specified herein.
 - i. Arrange for the shutdown of the equipment requiring field verification with the Owner, Investigations shall be done at a time, including after hours if necessary, which do not significantly interrupt the Owner's process operations.
2. Impedance Diagram: The presentation of the Impedance Diagram shall be on one or more 22 x 34-inch drawings with match lines if on multiple sheets, using font sizes which are easily readable. Include the following:
- a. Available fault current or impedance from the utility company.
 - b. Local generated capacity impedance.
 - c. Transformer and/or reactor impedances.
 - d. Cable impedances.

- e. System voltages.
- f. Grounding scheme (resistance grounding, solid grounding, or no grounding).
- 3. Calculations: Include the following:
 - a. Determine the paths and situations where short circuit currents are the greatest. Assume bolted faults and calculate the three-phase and line-to-ground short circuits of each case.
 - b. Calculate the maximum and minimum fault currents.
- F. Provide Time-Current Curves (TCC) on 8-1/2 x 11 log-log paper.
 - 1. The Time Current Curves shall be presented in series only. Parallel branches shall not appear on the same TCC presentation.
 - 2. Do not put more than one branch of protective devices on any one coordination curve.
 - 3. Show a maximum of five devices in series on one TCC. Include a one-line diagram and the names of each protective device in the branch on the coordination curve drawing. Use the same color for the same protective device appearing on different TCC presentations.
 - 4. Provide separate drawings for ground fault coordination curves.
 - 5. Use the names designated in the Contract Documents.
 - 6. Include motor starting curves and transformer inrush and damage curves, and cable short circuit withstand curves.

2.03 ARC FLASH HAZARD STUDY

- A. The Power System Study shall include an Arc Flash Hazard Study that shall present the level of arc flash hazard for each item of electrical equipment, and the appropriate level of protection required per OSHA standards.
- B. The analysis shall be performed with the aid of computer software intended for the purpose, to calculate Arc-Flash Incident Energy (AFIE) levels and flash protection boundary distances.
- C. The analysis shall be performed under each possible condition and shall identify the worst-case Arc-Flash condition. The preliminary report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.
- D. The calculations shall be performed in accordance with IEEE 1584 and safe approach requirements determined in accordance with NFPA-70E. (Latest versions)
- E. Results of the Analysis shall be submitted in tabular form on an Excel spread sheet, and shall include, device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment and AFIE levels. The analysis shall be presented on paper and included with the specified electronic format files.
- F. After approval of the Study, provide the Arc Flash Hazard Warning Labels. The Study Engineer shall oversee the installation of the required labels for each item of

electrical equipment furnished on the project and for each item of existing equipment for which the arc flash hazard has changed. A typical warning label shall be submitted with the Study for approval, and shall include the information listed below, at minimum.

1. Flash Hazard Protection Boundary.
 2. Limited Approach Boundary.
 3. Restricted Boundary.
 4. Incident Energy Level.
 5. Required Personal Protective Equipment Rating.
 6. Type of Fire Rated Clothing.
- G. Labels shall be affixed to the enclosures, in a readily visible location, for all power-handling equipment as follows.
1. Switchgear
 - a. One label for the line side of the main breaker
 - b. One label for the load side of the main breaker (switchgear bus)
 - c. One label on each vertical section, indicating the data for the switchgear bus
 2. MCCs
 - a. One label for the line side of the main breaker
 - b. One label for the load side of the main breaker (MCC bus)
 - c. One label on each vertical section, indicating the data for the MCC bus.
 3. Switchboards
 - a. One label for each switchboard operated at 480 Volts or above.
 - b. Label to indicate data for line side of the main breaker.
 4. Panelboards
 - a. One label for each panelboard operated at 480 Volts or above.
 - b. Label to indicate data for line side of the main breaker.
 5. Control panels, including combination starters.
 - a. Single label at each unit operated at 480 Volts or above.
 - b. Label to indicate data for the line side of the disconnect device.
 6. Disconnect switches.
 - a. Single label at each disconnect switch operated at 480 Volts or above.
 - b. Label to indicate data for the line side of the switch.
- H. Size of each label shall be not less than 4 inches wide and 3 inches tall. Two samples are shown below:

 DANGER	
	Arc Flash and Shock Hazard Appropriate PPE Required
_____ Nominal System Voltage	
_____ Arc Flash Boundary	
_____ Limited Approach Boundary	
_____ Restricted Approach Boundary	
_____ Incident Energy (cal/cm ²) at _____ inches	
Arc Flash PPE Category: _____	
Equipment ID: _____ Date: _____	

 DANGER	
Arc Flash and Shock Hazard Appropriate PPE Required	
Nominal System Voltage: _____	
Arc Flash Boundary: _____	
Limited Approach: _____	
Restricted Approach: _____	
Incident Energy: _____ cal/cm ²	
Working Distance: _____	
Arc Flash PPE Category: _____	
Min. Arc Rating of Clothing: _____ cal/cm ²	
Arc-Rated PPE	Additional PPE
☐ Long Sleeve Shirt	☐ Flash Suit Pants
☐ Long Pants	☐ Gloves
☐ Coverall	☐ Jacket
☐ Face Shield	☐ Hard Hat Liner
☐ Balaclava	☐ Cotton Underwear
☐ Flash Suit Hood	☐
☐ Flash Suit Jacket	☐
☐ Hard Hat	
☐ Safety Glasses	
☐ Safety Goggles	
☐ Hearing Protection	
☐ Leather Gloves	
☐ Leather Footwear	
Equipment ID: _____ Date: _____	

PART 3 EXECUTION
3.01 FIELD SERVICES

A. Label Installation Certification

1. When the label installation is complete, the Contractor, the Study Engineer and the Owner/Engineer shall jointly inspect each location and show to the Owner/Engineer's satisfaction that labels are installed in all the specified locations, and in any additional recommended locations indicated in the Study.

B. Training

1. Provide the services of the Arc-Flash Training Engineer to conduct a training program for the Owner's personnel. The class shall include the following:
 - a. The class shall be held for not less than one eight-hour day for each shift of maintenance and operational personnel.
 - b. The care, application and use of protective personal equipment described by the warning signs installed on the project.
 - c. Conduct training at a location onsite to be designated by the Owner. Include class sessions in the field at equipment locations as may be required for instruction.
 - d. Applicable information from the Power System Study shall be provided to all the attendees.
 - e. Submit a detailed class syllabus to the Engineer/Owner for review and approval prior to holding the training class.
 2. Provide the services of the Power System Study Engineer to conduct power system operation training for the Owner's personnel. The class shall include the following:
 - a. The class shall be held for not less than one eight-hour day for each shift of maintenance and operational personnel.
 - b. Instruction in the safe operation of the power system for both new electrical power distribution equipment included in the study and existing power distribution equipment which is in series with the new equipment.
 - c. The safe operation of electrical equipment Kirk Key interlocks.
 - d. Power system switching which avoids configurations that may exceed equipment short circuit ratings, or that may cause other undesirable or danger if certain circuits are paralleled.
 - e. Provide handout materials including one-line diagrams and O&M information for each person in attendance.
 - f. Submit a detailed class syllabus to the Engineer/Owner for review and approval prior to holding the training class.
- C. The cost of Field Services shall be included in the Contract Price and the schedule for training shall be included in the Contract Schedule.**
- D. The Owner reserves the right to videotape the training for the Owner's use.**

END OF SECTION

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SECTION 16110

RACEWAYS, BOXES, ENCLOSURES, AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install complete raceway systems as shown on the Drawings and as specified herein. A raceway system shall consist of materials designed expressly for containing wires and cables, including but not limited to, conduit, device bodies, conduit bodies, raceway boxes, enclosures containing electrical devices, controls, and related materials.
- B. Raceways and conductors that are listed on the raceway and conductor schedules are generally not shown on the Drawings, except where they are required to pass through a restricted or designated space. Raceways indicated to be run "exposed" on the schedules shall be run near the ceilings or along the walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes and hoists, lighting fixtures, doors, and hatches, etc. Raceways indicated to be run concealed shall be run in the center of concrete floor slabs, in partitions, or above hung ceilings, as required.

1.02 RELATED WORK

- A. Refer to Section 16000 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

- A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 16000, the following:
 - 1. Manufacturers' names and product designation or catalog numbers of all materials specified.
 - 2. Cut sheets for each individual item shall be submitted.
 - 3. Instruction for handling and storage.
 - 4. Installation instructions.
 - 5. Dimensions and weights.
- B. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.
- C. Submit to the Owner/Engineer, certification that the electricians installing the PVC coated conduit have a five-year minimum experience, in the installation of the product.

- D. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will also be returned without review.

1.04 REFERENCE CODES AND STANDARDS

- A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):
 - 1. NFPA 70 – National Electrical Code (NEC)
 - 2. NFPA 70E – Standard For Electrical Safety in the Workplace
 - 3. ANSI C80.5 – Electrical Rigid Aluminum Conduit
 - 4. UL 514B – Outlet Bodies
- B. All equipment components and completed assemblies specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.05 QUALITY ASSURANCE

- A. The manufacturer of these materials shall have produced similar electrical materials and equipment for a minimum period of five years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- B. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly. All assemblies shall be of the same manufacturer.
- C. The installer of materials specified herein, shall have a minimum of five years' experience in the installation of each type of material. Proof of experience shall be submitted, upon request of the Owner/Engineer, prior to installation.
- D. Used materials are unacceptable, will be rejected and shall be removed from the job site. Used materials, if installed, shall be removed, and replaced with new materials. If new materials are installed with used materials, and the removal of the used materials renders the new materials in an unacceptable condition, such as new conductors installed in used raceway components, (determined by the Engineer/Owner alone) then the new materials shall be removed along with the used materials and replaced. No increase in the Contract Price nor in Contract Schedule will be allowed.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

- A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer prior to delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, or equipment which failed any factory tests, will not be permitted.
- B. Materials shall be handled and stored in accordance with manufacturer's instructions.
- C. Materials shall not be stored exposed to sunlight. Such materials shall be completely covered.

- D. Materials showing signs of previous use, jobsite storage at another location, or exposure to the elements or other damage will be rejected.

1.07 WARRANTY

- A. Provide warranties, including the manufacturer's warranty, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

1.08 MEASUREMENT AND PAYMENT

- A. Refer to Section 16000.

PART 2 PRODUCTS

2.01 GENERAL

- A. Raceways and fittings shall be as shown on the Drawings, with a minimum 3/4-inch trade size.
- B. Device entries less than 3/4 inch shall be provided with an adaptor to connect 3/4-inch or larger conduit. The following adaptors are acceptable:
 - 1. REA12SA, Eaton or equal, for aluminum
 - 2. ADAPT ADU302930, REDAPT or equal, for 316 stainless.
 - 3. Approved equal.

2.02 CONDUIT RACEWAY

- A. PVC Coated Rigid Aluminum Conduit (CRMC)
 - 1. PVC coated rigid aluminum conduit shall have a minimum 0.040-inch thick, polyvinyl chloride coating permanently bonded to rigid aluminum conduit and an internal chemically cured urethane or enamel coating. Urethane coating shall be a minimum of 2 mil thickness on the interior of the conduit and the interior of fittings, conduit, covers, and bodies.
 - 2. Rigid Aluminum conduit shall be extruded from AA 6063 alloy in temper designation T-1 and shall conform to ANSI C80.5 and UL 6A.
 - 3. The ends of all couplings, fittings, etc. shall have a minimum of one pipe diameter in length of PVC overlap.
 - 4. Manufacturers for PVC coated conduit and fittings
 - a. Perma-Cote
 - b. Robroy Industries
 - c. O'Kote, Inc.
 - d. Calbond

- e. Ocal.
- f. NEC Inc (BlackGuard)
- g. Approved equal.
- 5. Elbows and couplings shall be PVC coated by the same manufacturer supplying the conduit PVC coating system. Elbows and couplings used with PVC coated conduit shall be furnished with a PVC coating bonded to the aluminum, the same thickness as used on the coated aluminum conduit.
- B. Liquid tight Aluminum Flexible Metal Conduit (LFMC)
 - 1. Liquid tight aluminum flexible metal conduit shall have an interlocked aluminum core, PVC jacket rated for 60 degrees C, and meeting NEC Article 351.
 - 2. Manufacturers
 - a. Anaconda Metal Hose Div.
 - b. Southwire
 - c. Anaconda American Brass Co.
 - d. American Flexible Conduit Co., Inc.
 - e. Universal Metal Hose Co.
 - f. ALFLEX
 - g. Approved equal.
 - 3. Fittings used with liquid tight flexible aluminum conduit shall be copper-free aluminum and shall conform to UL-514B.
 - 4. Couplings and fittings for use in hazardous areas shall comply with UL 886, NEC Article 501 & 502.
- C. Aluminum Flexible Metal Conduit (FMC)
 - 1. Aluminum flexible metal conduit shall have an interlocked aluminum core, meeting NEC Article 348, UL 1
 - 2. Manufacturers
 - a. Anaconda Metal Hose Div.
 - b. Southwire
 - c. Anaconda American Brass Co.
 - d. American Flexible Conduit Co., Inc.
 - e. Universal Metal Hose Co.
 - f. Approved equal.
 - 3. Fittings used with aluminum flexible metal conduit shall be copper-free aluminum.
- D. Rigid Aluminum Conduit (RMC)

1. Rigid Aluminum conduit shall be extruded from AA 6063 alloy in temper designation T-1 and shall conform to ANSI C80.5 and UL 6A.
 2. Manufacturer for rigid aluminum conduit and fittings
 - a. Wheatland Tube Company
 - b. Allied
 - c. American Conduit
 - d. Patriot Industries
 - e. Approved equal.
- E. Rigid PVC Schedule 40 Conduit (RNC)
1. Schedule 40 PVC Rigid Nonmetallic Conduit (RNC) shall be designed for use underground as described in the NEC, resistant to sunlight. The conduits and fittings shall be manufactured to NEMA TC-2 and UL 651 specifications. Fittings shall be manufactured to NEMA TC-3 and UL 514B. Conduit shall have a UL Label.
 2. Manufacturers
 - a. Rocky Mountain Colby
 - b. Carlon
 - c. Kraloy
 - d. Heritage Plastics
 - e. Approved equal.
- F. Rigid PVC Schedule 80 Conduit (RNC)
1. Schedule 80 PVC Rigid Nonmetallic Conduit (RNC) shall be designed for use above ground and underground as described in the NEC, resistant to sunlight. The conduits and fittings shall be manufactured to NEMA TC-2 and UL 651 specifications. Fittings shall be manufactured to NEMA TC-3 and UL 514B. Conduit shall have a UL Label.
 2. Manufacturers
 - a. Rocky Mountain Colby
 - b. Carlon
 - c. Kraloy
 - d. Heritage Plastics
 - e. Approved equal.

2.03 WIREWAYS

- A. All wireways shall be NEMA 4X 316 stainless steel, with gasketed hinged covers and stainless steel quick-release type latches. Wireway shall have two Breather/Drains for each ten feet of wireway. Breather/Drain shall be in the bottom,

near the ends of the wireway. Wireways shall have integral welded mounting lugs. Bolted-on mounting lugs are unacceptable. Provide stainless steel internal barriers to isolate signal cables from power conductors and multiconductor digital control cables.

B. Manufacturers

1. Industrial Enclosure Corporation
2. Eaton
3. Approved equal.

C. Breather/Drains

1. Eaton 316 stainless steel
2. Approved equal.

2.04 RACEWAY BOXES AND EQUIPMENT ENCLOSURES

A. The term box and enclosure are synonymous for this specification. Boxes and enclosures specified herein, include terminal boxes, junction boxes, pull boxes, and boxes for switch, receptacles, and lighting. Enclosures used for electrical and instrumentation equipment, other than terminal boxes, shall be provided as described in this section with references to this specification in other specification sections. All raceway boxes and equipment enclosures shall be provided with a common ground point and shall be UL rated.

B. NEMA Type 4X boxes shall be 316 stainless steel only as otherwise specified or shown with mounting lugs or brackets welded on the box, suitable for wall mounting, or have mounting feet where self-standing. Boxes for wall-mounting shall have integral welded-on mounting lugs. Enclosures with mounting feet shall have the mounting feet brackets for the attachment of mounting feet welded on. Boxes manufactured with holes intended for mounting using bolted-on mounting lugs or feet are not acceptable. Drilling through the back of the box to mount is strictly prohibited. Drilled boxes shall be removed and replaced. All boxes shall have continuously welded seams ground smooth, and shall have continuous hinged, gasketed doors. Box bodies shall not be less than 16 gauge. Boxes larger than 24 inches X 20 inches shall have a three-point type latch with handle. Boxes 24 inches X 20 inches or smaller shall have 316 stainless steel luggage type quick release latches, or three-point latch system with all components 316 stainless steel. Latch systems requiring tools to open or close are unacceptable.

C. NEMA 4X 316 Stainless Steel enclosures

1. Use for all locations unless otherwise shown or specified
2. Type 316 stainless steel, body, and door
3. Stainless steel continuous hinge
4. Foam in-place gasket
5. Single point quarter turn latches (20-inch X 24-inch and smaller). All others shall have three-point.

6. Manufacturers
 - a. Enclosures housing electrical equipment may be constructed by the manufacturer of that equipment but shall meet the all the physical requirements specified herein.
 - b. Eaton
 - c. Hoffman
 - d. Appleton Electric
 - e. EMF Company
 - f. NEMA Enclosures Company
 - g. Rittal
 - h. Approved equal.
- D. NEMA 6P Stainless steel Submersible [Where shown on the Drawings] boxes shall meet NEMA 6P, 4, 4X, and IP68 shall be constructed as follows:
 1. 14 gauge (minimum) 316 Marine Grade Stainless Steel body, and door
 2. Seems continuously welded and dressed.
 3. Single piece Neoprene gasket
 4. Minimum flange width to maximize internal capacity.
 5. Mounting brackens welded on enclosure for direct wall mounting.
 6. Grounding stud on body
 7. Mounting stud for optional internal mounting plates
 8. Manufacturers
 - a. Enclosures housing electrical equipment may be constructed by the manufacturer of that equipment but shall meet the all the physical requirements specified herein.
 - b. Slayson
 - c. Approved equal.
- E. Chemical Rooms and areas specified or shown to be corrosive: NEMA 4X nonmetallic boxes shall be constructed as follows:
 1. PVC or Fiberglass reinforced polyester body and door.
 2. UV inhibitors
 3. UL Listed
 4. RoHS compliant
 5. Formed in place polyurethane gasket in continuous channel.
 6. 316 Stainless steel quick release latches.

7. Manufacturers
 - a. Enclosures housing electrical equipment may be constructed by the manufacturer of that equipment but shall meet the all the physical requirements specified herein.
 - b. Allied Molded Products, Inc.
 - c. Cantex
 - d. Eaton
 - e. Hoffman
 - f. Hubbell-Wiegmann Non-Metallic
 - g. Approved equal.
- F. Classified Areas, NEMA 7/4X boxes (Class 1, Division 1, Groups A, B, C, and D, or as defined in NFPA 70) shall be constructed as follows:
 1. Copper free cast aluminum body and cover
 2. Stainless steel hinges
 3. Watertight neoprene gasket
 4. Stainless steel quarter turn cover bolts with metallic handles] [Stainless steel quick release latches.
 5. Manufacturers
 - a. Enclosures housing electrical equipment may be constructed by the manufacturer of that equipment but shall meet the all the physical requirements specified herein.
 - b. Eaton
 - c. Appleton Electric
 - d. Approved equal.
- G. NEMA 12 boxes where shown on the drawings shall be constructed as follows:
 1. Type 5052 aluminum, body and door
 2. Stainless steel continuous hinge
 3. Foam in-place gasket
 4. Single point quarter turn latches (20-inch X 24-inch and below). All others three-point latch
 5. Manufacturers
 - a. Enclosures housing electrical equipment may be constructed by the manufacturer of that equipment but shall meet the all the physical requirements specified herein.
 - b. Hoffman

- c. EMF Company
- d. NEMA Enclosures Company
- e. Eaton
- f. Approved equal.

H. NEMA 1 or NEMA 1A boxes shall not be used.

I. Malleable iron boxes shall not be used.

2.05 DEVICE BOXES

A. Device boxes installed in aluminum raceway systems for switches and receptacle, etc., shall be copper free cast aluminum, and shall have tapered, threaded, hubs, with integral bushings. Boxes shall have internal grounding screw, and a minimum of two mounting feet. Boxes shall be type FD.

B. Manufacturers

- 1. Eaton
- 2. Appleton
- 3. Approved equal.

2.06 CONDUIT OUTLET BODIES

A. Conduit outlet bodies and covers shall be Form 7, copper-free aluminum, with captive screw-clamp cover, neoprene gasket and stainless-steel screws and clamps for conduits up to and including 2-1/2 inches.

B. Manufacturers

- 1. Eaton Form 7 with Mark 7 wedge-nut cover
- 2. Appleton
- 3. Approved equal.

C. Provide junction boxes for conduits larger than 2-1/2 inches.

D. All outlet boxes and covers for Class 1 Division 2 areas shall be rated NEMA 4X.

1. Manufacturers

- a. Eaton EA Series
- b. Approved equal.

2.07 CONDUIT HUBS

A. Conduit hubs for use on raceway system pull and junction boxes shall be watertight, threaded aluminum, insulated throat, stainless steel grounding screw

B. Manufacturers

- 1. T&B H150GRA Series
- 2. Approved equal.

2.08 GROUNDING BUSHINGS

- A. Grounding bushings shall be copper free aluminum, insulated lay-in lug grounding bushings with tin-plated copper grounding path. Bushings shall have integrally molded noncombustible phenolic insulated surfaces rated 150°C. Each bushing shall be furnished with a plastic insert cap. The size of the lug shall be sufficient to accommodate the maximum ground wire size required by the NEC for the application.
- B. Manufacturers
 - 1. O-Z/Gedney Type ABLG
 - 2. Approved equal.

2.09 RACEWAY SEALANT

- A. Raceway sealant for use in the sealing of raceway hubs, entering or terminating in boxes or enclosures where such sealing is shown or specified, shall be 3M 1000NS Watertight Sealant, or approved equal.
- B. For cable bundles up to seven cables, in a duct entering a building, use Tyco RDSS Duct Sealing Product. For cable bundles of more than seven cables, in a duct entering a building, use 3M 1000NS Watertight Sealant.

2.10 CONDUIT PENETRATION SEALS

- A. Conduit wall and floor seals
 - 1. O.Z./Gedney Co. Series CSM
 - a. Type CSML-XXXP shall be used for all applications that do not require a recessed sealing bushing.
 - b. Type CSMI-XXXP shall be used for all applications that require a recessed sealing bushing.
 - c. Approved equal.

2.11 EXPANSION-DEFLECTION COUPLING

- A. Combination expansion-deflection fittings with 3/4-inch axial expansion and contraction movement, 3/4-inch parallel misalignment movement, and up to 30 degrees of angular movement in any direction. It shall be copper-free aluminum, with exterior tinned copper braid bonding jumper and 316 stainless grounding straps
- B. Manufacturers
 - 1. Eaton Model XD
 - 2. Approved equal.
- C. When installed outdoors, exposed to direct sun light, provide an aluminum cover over the fitting to protect the rubber portions. Secure the aluminum sun shield with a minim of two stainless steel tie wraps. See detail on the Drawings
- D. Nylon tie wraps are not acceptable.

2.12 EXPANSION FITTINGS

- A. Expansion fittings shall provide eight-inch movement, shall be made of copper-free aluminum, with exterior tinned copper braid bonding jumper and 316 stainless grounding straps. Provide internal grounding. Nylon tie wraps are not acceptable.
- B. Manufacturers
 - 1. Eaton Type XJGSA
 - 2. Approved equal.

2.13 EXPLOSION-PROOF SEALS, BREATHERS AND DRAINS

- A. Explosion proof fittings shall be designed for Class 1 Division 1, Group D, hazardous locations. Fittings shall be copper-free aluminum, with seals, breathers and drains. Provide type ED, or as required for the application. Provide PVC coated aluminum type explosion proof fittings for wet location.
- B. Manufacturers
 - 1. Eaton
 - 2. Appleton Electric Co.
 - 3. O.Z./Gedney Co.
 - 4. Approved equal.

2.14 KELLEMS GRIPS

- A. Kellems grips cables supports shall be Kevlar material.

2.15 CONDUIT MOUNTING EQUIPMENT

- A. Pull and junction box supports, spacers, conduit support rods, clamps, hangers, channel, nut, bolts, washers, etc. and shall be 316 stainless steel. Nylon tie wraps are not acceptable.

2.16 CONDUIT IDENTIFICATION TAGGING

- A. Tag all underground conduits at all locations exiting and entering from underground, including manholes and handholes. Use the tagging formats for conduits as shown on the drawings.
- B. Use the tagging formats for conduits as shown on the drawings. Where modifications or additions are made to existing equipment replace existing tags with new modified tags.
- C. Conduit identification plates shall be embossed stainless steel with stainless steel band, permanently secured to the conduit without screws. Nylon tie wraps are not acceptable.
- D. Conduit identification plates shall be as specified in Section 16195 – Electrical Identification.

PART 3 EXECUTION**3.01 RACEWAY APPLICATIONS**

- A. Unless exact locations are shown on the Drawings, coordinate the placement of raceway systems and related components with other trades and existing installations.
- B. Raceway Systems for the installation of Fiber Optic Cables shall not contain conduit bodies, device boxes, or raceway boxes containing less than twelve inches of bend radius.
- C. Unless shown on the Drawings or specified otherwise, the raceway type installed with respect to the location shall be as follows, including all materials:

Raceway System	Location
1. PVC Coated Aluminum (CRMC) Type	All embedded raceway bends, underground duct bank bends of more than 20 degrees, and all raceway stub-ups to a minimum of six inches above finished floor or grade and in Chlorine and Caustic rooms.
2. Liquidtight Flexible Aluminum (LFMC) Type	Raceway connection to vibrating equipment, and as shown on the Drawings in all areas.
3. Rigid Non-metallic, Schedule 40 PVC (RNC) Type	Underground encased in red dyed reinforced concrete.
4. Rigid Non-metallic, Schedule 80 PVC (RNC) Type	For use only in Chlorine and Caustic Rooms.
5. Flexible Aluminum (FMC) Type	Fixture whip connection to lighting fixtures in NEMA 12 areas (maximum 3-feet). BX or AC type prefabricated cables are not permitted.
6. Aluminum Rigid Metal (RMC) Type	All above grade areas, except for concrete embedded and those areas described above.

- D. All conduit of a given type shall be the product of one manufacturer.

3.02 BOX APPLICATIONS

- A. All raceway junction boxes, pull and terminal boxes and electrical equipment enclosures shall have NEMA ratings for the location in which they are installed, and as specified herein.
- B. The distance between each raceway entry inside the box and the opposite wall of the box shall not be less than eight times the metric designator (trade size) of the largest raceway in a row. This distance shall be increased for additional entries by the amount of the sum of the diameters of all other raceway entries in the same row on the same wall of the box. Each row shall be calculated individually, and the single row that provides the maximum distance shall be used.

- C. Provide cast aluminum conduit fittings for exposed switch, receptacle and lighting outlet boxes.
- D. All raceway boxes and wall – mounted electrical equipment enclosures shall be provided with factory mounting integral welded mounting lugs. Bolt-on gasketed mounting lugs attached through factory-drilled holes are not acceptable for any raceway box or electrical equipment enclosure. Drilling through the back of any box or enclosure is prohibited, and if so installed, shall be removed, and replaced, with no increase in the Contract Price or Construction Schedule.
- E. No penetrations shall be made in the top of boxes or electrical equipment enclosures in wet locations.
- F. Boxes for use only on concealed, above ground, interior electrical wiring, in air-conditioned administrative buildings remote to the process area, may be NEMA 1 galvanized boxes as specified for such areas. All boxes used in such areas, for exposed wiring, shall be NEMA 12 aluminum or 316 stainless steel as specified above.

3.03 DEVICE BOX APPLICATIONS

- A. Device boxes shall be used for mounting wiring devices such as receptacles, switches, thermostats, lighting, and other permanently mounted devices. All device boxes shall be installed with a minimum of 1/4-inch air space between the back of the box and the wall or back panel on which it is installed. The space may be created with enough 316 stainless steel washers to provide the required air space or may be mounted using 316 stainless steel slotted channel.

3.04 CONDUIT OUTLET BODIES APPLICATIONS

- A. Conduit outlet bodies may be used on conduits up to and including 2-1/2 inches, except where junction boxes are shown or otherwise specified. For conduits larger than 2-1/2 inches, junction boxes shall be provided.

3.05 CONDUIT HUB APPLICATIONS

- A. Unless specifically stated herein or described on the Drawings, all raceways shall terminate at an outlet with a conduit hub. Locknut or double locknut terminations will not be permitted.
- B. When conduits contain equipment grounding conductors the wire shall be grounded to the hub(s) associated with that grounding conductor.

3.06 INSULATED GROUNDING BUSHING APPLICATIONS

- A. Insulated grounding bushings shall be provided and used to terminate raceways where the raceways enter pad-mounted electrical equipment or switchgear from the bottom where there is no wall or floor pan on which to anchor or terminate the raceway.
- B. All other raceways shall terminate on enclosures with a conduit hub, except for NEMA 7/4X areas.

- C. Grounding bushing caps shall remain on the bushing until the wire is ready to be pulled.

3.07 CONDUIT FITTINGS APPLICATIONS

- A. Combination expansion-deflection fittings shall be installed where conduits cross structure expansion joints and installed in exposed conduit runs such that the distance between expansion-deflection fittings does not exceed 150 feet of conduit run. Expansion-deflection fittings are acceptable in indoor locations out of exposure to direct sunlight or other outdoor locations which are shaded.
- B. Combination expansion-deflection fittings are not acceptable for use outdoors unless approved in writing on a case-by-case basis from the Engineer/Owner. Where combination expansion-deflection fittings with exposed non-metallic sections, are approved by the Engineer/Owner for use where exposed to sunlight or other outdoor locations which are shaded, an aluminum wrap shall be installed loosely over the non-metallic portion, extending at least two inches beyond the ends. The wrap shall be loosely secured, to permit movement, with at least two 316 SS fasteners. Nylon tie-wraps are not acceptable.
- C. Provide an expansion fitting with a minimum of six inches available movement shall be installed on the exposed side of under to above grade conduit transitions. Expansion-deflection fittings shall not be provided unless approved and protected as specified above.

3.08 CONDUIT PENETRATION SEALS APPLICATIONS

- A. Conduit wall seals shall be used where underground conduits penetrate walls or at other locations shown on the Drawings.
- B. Conduit sealing bushings shall be used to seal conduit ends exposed to the weather and at other locations shown on the Drawings.

3.09 EXPLOSION-PROOF SEALS, BREATHERS AND DRAINS APPLICATIONS

- A. Fittings consisting of sealing fittings, breathers, drains, with sealing compound and fiber, as specified herein, shall be used as required to meet all the requirements of the National Electrical Code.

3.10 CONDUIT TAG APPLICATIONS

- A. All conduits shall be tagged within one foot of the entry of equipment, and wall and floor penetrations.
- B. Tag all underground conduits and ducts at all locations, exiting and entering from underground, including manholes and handholes.

3.11 RACEWAY SEALING

- A. All raceways entering junction boxes, terminal junction boxes, electrical equipment enclosures or control panels containing electrical, or instrumentation equipment shall be connected to the box, enclosure or panel using conduit hubs and shall be sealed with Raceway Sealant, as specified herein.

3.12 PVC RACEWAY TO PVC COATED ALUMINUM RACEWAY TRANSITIONS IN CONCRETE ENCASEMENT

- A. Transitions from PVC raceway to PVC coated aluminum raceway in concrete encasements shall be made as follows:
 - 1. Terminate the PVC conduit in a threaded PVC female adapter.
 - 2. Terminate the PVC coated aluminum conduit in a threaded male adaptor.
 - 3. Thread the male PVC-coated aluminum conduit adaptor into the female threaded PVC adapter.
- B. Tighten the joint securely, then double layer wrap the joint with two-inch vinyl electrical tape for two inches each side of the threaded joint to prevent any contact between any exposed aluminum threads and concrete.

3.13 RACEWAY INSTALLATION

- A. Do not install pull wires and conductors until the raceway system is in place. No wire shall be installed between outlet points, junction points or splicing points, until all raceway sections are complete, and all raceway covers are installed for protection of conductors from damage or exposure to the elements. Conductors installed into incomplete raceway systems are considered improperly installed and are in violation of the NEC. The occurrence of wire installed in an incomplete installation, shall require the removal of such conductors from the project site, and replacement of the conductors at with no increase in Contract Price or Schedule. The raceway system shall be completed and inspected by the Engineer/Owner before new conductors are installed.
- B. No conduit smaller than 3/4-inch electrical trade size, shall be used, nor shall any have more than the equivalent of three 90-degree bends in any one run. Pull boxes shall be provided as necessary. Conduit reducers which are the same type of the raceway shall be installed where manufacturer-provided enclosures are not available with conduit hubs larger than 1/2-inch at the enclosure to terminate 3/4-inch conduit. The raceway fill shall be adjusted to accommodate the smaller opening in the manufacturer-provided enclosure. Notify the Engineer/Owner prior to the installation of the raceway into enclosures with openings smaller than the specified minimum. Raceways installed without notice are considered unacceptable and may be required to be removed at the Engineer's/Owner's discretion with no increase in the Contract Price or Schedule allowed.
- C. All raceways, installed underground, shall be installed in accordance with Section 16600 Underground System, and be a minimum size of two-inch trade size unless otherwise shown in the plans.
- D. Raceways entering or leaving the raceway system, which could be subjected to the entry of moisture, rain, or liquid of any type, shall be tightly sealed, using 3M 1000NS Watertight Sealant, or approved equal at any possible moisture entry point both before and after the installation of cables to prevent the entry of water or moisture to the Raceway System at any time. Any damage to new or existing equipment, due to the entrance of moisture from unsealed raceways, shall be

corrected by complete replacement of such equipment. No increase in the Contract Price or Schedule will be allowed. Cleaning or drying of such damaged equipment will not be acceptable.

- E. Conduit supports, other than for underground raceways, shall be spaced at intervals of eight feet or less, as required by the NEC and as required to obtain rigid construction. Conduits shall be supported near the entry into any enclosure in accordance with the NEC. Conduits shall not be used to support other conduits, nor shall conduits be supported from cable tray.
- F. Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface.
- G. Multiple runs of conduits shall be supported on trapeze type hangers with horizontal members and threaded hanger rods. The rods shall be not less than 3/8-inch diameter. Multiple conduits mounted on walls shall be supported using strut and 316 stainless steel conduit clamps, screws, nuts and washers.
- H. Surface mounted panel boxes, junction boxes, conduit, etc. shall be supported as specified herein.
- I. Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, anchors shall be as specified in Section 16045 Electrical Support Hardware.
- J. No electrical equipment enclosures, boxes, terminal junction boxes or raceways shall be attached to or supported from, sheet metal walls.
- K. All conduits on exposed work shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. Offsets in conduit runs shall all be done at the same point and shall all be the same angle, so the entire installation appears to be parallel or concentric at every point. All conduits shall be run perfectly straight and true.
- L. Conduits terminated into enclosures shall be perpendicular to the walls where flexible liquid tight or rigid conduits are required. The use of short seal tight elbow fittings for such terminations will not be permitted, except for connections to instrumentation transmitters, where multiple penetrations are required.
- M. Conduits containing equipment grounding conductors and terminating in boxes shall have insulated throat grounding bushings. The grounding conductor shall be grounded to the box.
- N. Conduits shall be installed using threaded fittings. Running threads will not be permitted.
- O. Provide glued type conduit fittings on PVC conduit.
- P. Conduits installed which are not in compliance with these requirements shall be removed and reinstalled at the Engineer's/Owner's discretion. If conductors are installed when the improper installation is discovered, the conductors shall be removed from the raceway, discarded, and removed from the job site,

replaced, re-terminated, retagged, and retested in accordance with the specifications. The function of the system shall be retested in its entirety. No increase in Contract Time or Schedule will be allowed.

- Q. Liquid tight flexible metallic conduit shall be used for the primary and secondary of transformers, generator terminations and other equipment where vibration is present. Use in other locations is not permitted, except for connections to instrumentation transmitters, where multiple penetrations are required. Liquid tight flexible metallic conduit shall have a maximum length not greater than that of a factory manufactured elbow of the conduit size being used. The maximum bending radius shall not be less than that shown in the NEC Chapter 9, Table 2, "Other Bends". BX or AC type prefabricated cables will not be permitted.
- R. Seal the remaining openings or spaces of conduits passing through openings in walls or floor slabs to prevent the passage of flame or smoke where additional openings or space around the conduits are present.
- S. Conduit ends exposed to the weather or corrosive gases shall be sealed with conduit sealing bushings.
- T. Raceways terminating in Control Panels or enclosures outdoors or any wet or damp location or any location where plant process equipment is located, or any location not otherwise specifically designated as a dry electrical room, control room or office space, which contain electrical equipment or terminal blocks, shall not enter from the top of the enclosure. The raceways shall be sealed with a watertight sealant as specified herein. Enclosures entered from the top where top entry is prohibited, will be rejected, and shall be removed and replaced regardless of the Division which contains the specification for the enclosure. The use of UL Listed conduit closures to restore the NEMA rating of the enclosure will not be accepted. Conduit entering the top of the enclosures shall be removed and re-routed to enter the enclosure from the side or bottom. Conductors installed in top entering conduits shall be pulled back to the nearest conduit body or junction box and re-routed with the conduit, provided the conductors are long enough to be re-terminated. Conductors found to be insufficient in length to be re-terminated shall be completely removed and replaced, re-tested, re-tagged, re-tested and the control function of the panel shall be re-tested. If the enclosure is provided by an OEM, the enclosure and its contents shall be returned to the OEM for a new enclosure. No increase in Contract Price nor increase in Contract Time will be allowed for making these corrections.
- U. All conduits from external sources entering or leaving a multiple compartment enclosure shall be stubbed up into the bottom horizontal wire way or other manufacturer designated area, directly below the vertical section in which the conductors are to be terminated. Conduits entering from cable tray shall be stubbed into the upper section.
- V. Conduit sealing and drain fittings shall be installed in areas designated as NEMA 4X or 7 and all wet locations.

- W. A conduit identification plate shall be installed on all power, instrumentation, alarm, and control conduits at each end of the run and at intermediate junction boxes, manholes, etc. Conduit plates shall be installed before conductors are pulled into conduits. Exact identification plate location shall be coordinated with the Owner/Engineer at the time of installation to provide uniformity of placement and ease of reading. Conduit numbers shall be exactly as shown on the Drawings.
- X. Mandrels shall be pulled through all existing conduits that will be reused and through all new conduits two inches in diameter and larger prior to installing conductors.
- Y. 3/16-inch polypropylene pull lines shall be installed in all new conduits noted as spares or designated for future equipment.
- Z. All conduit that may under any circumstance contain liquids such as water, condensation, liquid chemicals, etc. shall be arranged to drain away from the equipment served. If conduit drainage is not possible, conduit seals shall be used to plug the conduits at the point of attachment to the equipment.
- AA. Conduits shall not cross pipe shafts, access hatches or vent duct openings. They shall be routed to avoid such present or future openings in floor or ceiling construction.
- BB. The use of running threads is prohibited. Where such threads are necessary, a three-piece union shall be used.
- CC. Conduits passing from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc. shall be sealed with Watertight Sealant as specified herein.
- DD. Conduits shall be located a minimum of three inches from steam or hot water piping. Where crossings are unavoidable, the conduit shall be kept at least one inch from the covering of the pipe crossed.
- EE. Conduits terminating at a cable tray shall be supported independently from the cable tray. Provide a conduit support within one foot of the cable tray. The weight of the conduit shall not bear on the cable tray.
- FF. Conduits entering the top of electrical equipment enclosures from cable tray or otherwise routed from above the equipment in airconditioned dry indoor spaces shall coordinate their placement with the HVAC duct vents such that cold air from the HVAC system will not blow directly on the vertical conduits causing condensation. Conduits which cannot be located away from direct exposure to cold air from the HVAC system shall be insulated to prevent condensation from forming inside the conduits or shall be re-routed. In all cases, condensation caused by cold air from the HVAC system shall be prevented from entering electrical enclosures. Equipment damaged by water from condensation shall be removed, replaced, conductors re-terminated, and its operation retested with no change in the contract price or schedule.

GG. All changes of direction on PVC coated conduit greater than 20 degrees shall be accomplished using long radius bends. Any field bends shall be made using equipment designed to prevent damage to the PVC coating.

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SECTION 16120

LOW-VOLTAGE WIRES AND CABLES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish, install and test all wire, cable and appurtenances as shown on the Drawings and as specified herein.
- B. This Section shall apply to all temporary and permanent feeders used on the project.

1.02 RELATED WORK

- A. Refer to Section 16000 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

- A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 16000, the following:
 - 1. Manufacturers' names and product designation or catalog numbers of all materials specified.
 - 2. Cut sheets for each individual item shall be submitted. Completed engineer's data sheets.
 - 3. Completed manufacturer's data sheets.
 - 4. Manufacturer's cut sheets, catalog data.
 - 5. Installation, terminating and splicing procedure.
 - 6. Instruction for handling and storage.
 - 7. Dimensions and weight.
 - 8. Conformance certificate
- B. Shop Drawings
 - 1. Submit catalog data of all wire and cable, connectors, and accessories, specified under this Section with all selections, options and exceptions clearly indicated. All cut sheets shall be clearly marked to indicate which products are being submitted for use on this project to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.
- C. Certified Tests
 - 1. Submit a test report of all installed wire insulation tests.
 - 2. Conformance Certificate and Quality Assurance Release: Submit a conformance certificate signed by the person responsible for product quality. The certificate shall specifically identify the purchased material or equipment, such as

by the project name and location, purchase order number, supplements, and item number where applicable, including materials and services provided by others. The certificate shall indicate that requirements have been met and identify any approved deviations.

1.04 REFERENCE CODES AND STANDARDS

- A. The equipment in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):
 - 1. NFPA 70 – National Electrical Code (NEC)
 - 2. NEMA WC-5 – Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 - 3. ANSI/TIA/EIA 606A – Standard for telecommunications Infrastructure
 - 4. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA 70 - National Electrical Code (NEC), Article 310 - Conductors for General Wiring
- B. Underwriters' Laboratories (UL):
 - 1. UL 83: Thermoplastic Insulated Wires and Cables
 - 2. UL 1063: Machine Tool Wires and Cables
- C. American Society for Testing and Materials (ASTM):
 - 1. ASTM B 3: Soft or Annealed Copper Wires
 - 2. ASTM B 8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft
 - 3. ASTM B 33 - Tinned Soft or Annealed Copper Wire for Electrical Purposes.
 - 4. ASTM B 174 - Bunch-stranded Copper Conductors for Electrical Conductors
- D. Insulated Cable Engineers Association (ICEA):
 - 1. ICEA S-61-402 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5).
 - 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). Insulated Cable Engineers Association (ICEA),
 - 4. ICEA S-61-402: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5)
- E. Institute of Electrical and Electronics Engineers (IEEE), IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables and Field Splices.
- F. City of Friendswood Electrical Code

1.05 QUALITY ASSURANCE

- A. The general construction of the wire, cables and the insulation material used shall be like that used for cable of the same size and rating in continuous production for at least 15 years and successfully operating in the field in substantial quantities.
- B. Wire and cable with a manufacture date of greater than 12 months previous will not be acceptable.
- C. Wire and cable shall be in new condition, with the manufacturer's packaging intact, stored indoors since manufacture, and shall not have been subjected to the weather. Date of manufacture shall be clearly visible on each reel.
- D. The manufacturer of these materials shall have produced similar electrical materials for a minimum period of five years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- E. Tests: Cable shall be tested at the factory to confirm that the cable complies with requirements of Part 6 of ICEA S-61-402, S-66-524 or S-68-516. Refer to data sheet for additional test requirements.
- F. Where applicable, the cable shall meet the requirements of the vertical tray flame test as described in IEEE 383-2.5.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

- A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer prior to delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, or equipment which failed any factory tests, will not be permitted.
- B. Check for reels not completely restrained, reels with interlocking flanges or broken flanges, damaged reel covering or any other indication of damage. Do not drop reels from any height.
- C. Unload reels using a sling and spreader bar. Roll reels in the direction of the arrows shown on the reel and on surfaces free of obstructions that could damage the wire and cable.
- D. Store cable on a solid, well drained location. Cover cable reels with plastic sheeting or tarpaulin. Do not lay reels flat.

1.07 WARRANTY

- A. Provide warranties, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

1.08 MEASUREMENT AND PAYMENT

- A. Refer to Section 16000.

PART 2 PRODUCTS

2.01 GENERAL

- A. Wires and cables shall be annealed, 98% conductivity, soft drawn copper.
- B. All conductors shall be Class B stranded.
- C. Except for control, signal and instrumentation circuits, wire smaller than #12 AWG shall not be used.

2.02 POWER & BUILDING WIRE

- A. Design. Provide cable with the following design characteristic. Cable shall be UL 44 or UL 83 listed, rated 600 volts and certified for continuous operation at the temperature as specified on the 600 Volt Power Cable Data Sheets while installed in underground duct, conduit, or cable tray. Cables shall be single-conductor or multi-conductor (with ground) as specified on the data sheets.
- B. Conductors. Provide conductors which are Class B, concentric stranded, annealed copper coated, unless otherwise specified on the data sheets, with physical and electrical properties conforming to ASTM B 3, ASTM B 8 or ASTM B 33 and Part 2 of ICEA S-61-402, S-66-524, or S-68-516. The number and size of conductors supplied in each cable shall correspond to the quantities specified on the data sheets.
- C. Insulation. Insulate each conductor as specified on the 600 Volt Power Cable Data Sheets to meet the requirements of Part 3 of ICEA S-61-402, S-66-524 or S-68-516. The insulation thickness shall match the dimensions listed in Section 3.2, Table 3-1 of ICEA S-61-402, S 66 524 or S-68-516, as specified on the data sheets.
- D. Jacket.
 - 1. When power cables are to be enclosed in conduit, ducts or in other raceway systems, multiconductor power cables shall be of the non-metallic type and shall be covered by an overall nonmetallic jacket as specified on the Data Sheets, which complies with the requirements of Section 4.4 of ICEA S-66-524 or S-68-516, Section 4.3 of ICEA S-61-402, or Table 21-5 of Part 21 of UL 83.
 - 2. Single-conductor cables shall have a jacket thickness which meets the requirements of Table 4-4 of Part 4 of ICEA S-66-524, Table 4-2 of Part 4 of ICEA S-68-516, or Table 4-2 or 4-6 of Part 4 of ICEA S-61-402. Multi-conductor cables shall have a jacket thickness which complies with Table 4-7 of Part 4 of ICEA S-66-524, Table 4-2 of Part 4 of ICEA S-68-516, Table 4-5 of Part 4 of ICEA S-68-516, or Table 4-6 of Part 4 of ICEA S-61-402, unless otherwise specified on the data sheets.
- E. Armor. When power cables are to be exposed in a cable tray, cable channel or other cable support systems, the multiconductor power cables shall be protected by an interlocked metal armor made of galvanized steel which meets the requirements of

paragraph 4.5 of ICEA S-68-516 or S-66-524 unless otherwise specified on the data sheets. An over-all jacket shall be provided as specified in the data sheets.

- F. Cable Marking. Print cable marking information on the overall cable jacket at 2-foot intervals. Use a permanent printing method and color sharply contrasting with the jacket color. Identify individual conductors as specified on the data sheets in conformance with Part 5 of ICEA S-61-402, S-66-524, and S-68-516.
- G. All building wire shall be stranded copper conductors, Type XHHW-2
- H. Manufacturers
 - 1. Southwire
 - 2. General Cable
 - 3. Okonite
 - 4. Approved equal.

2.03 VARIABLE FREQUENCY DRIVE CABLE

- A. Cable for use with VFDs shall be symmetrical design, three stranded Class D, tinned copper, circuit conductors with XLPE insulation, three bare copper grounds, 100% shields with 50% overlap, and overall PVC jacket. Cable shall be 2000 volt, UL 1277 Type TC, XHHW-2 rated, 90°C., IEEE 1202/383.
- B. Manufacturers
 - 1. Belden
 - 2. General Cable
 - 3. Southwire
 - 4. Okonite
 - 5. Approved equal.

2.04 TRAY CABLE

- A. Cable for tray use shall be stranded copper conductors, Type XHHW-2 insulation, rated as UL Type TC cable. Cable shall be sunlight resistant and approved for direct burial.
- B. Manufacturers
 - 1. Southwire
 - 2. General Cable
 - 3. Okonite
 - 4. Approved equal.

2.05 GROUNDING ELECTRODE CONDUCTOR

- A. Grounding electrode conductor shall be stranded copper conductor, Type XHHW-2 with green insulation.

- B. Manufacturers
 - 1. Southwire
 - 2. General Cable
 - 3. Okonite
 - 4. Approved equal.

2.06 BONDING JUMPER

- A. Bonding Jumper shall be bare tinned stranded copper conductor.
- B. Manufacturers
 - 1. Southwire
 - 2. General Cable
 - 3. Okonite
 - 4. Approved equal.

2.07 CONTROL WIRE AND CABLE

- A. Control wire shall be NEC Type XHHW-2.
- B. Multi-conductor control cable, shall be stranded, #14 AWG 600-volt, XHHW-2, insulated, PVC outer jacket overall, Type TC, UL rated for underground wet location.
- C. Manufacturers
 - 1. Southwire
 - 2. Okonite
 - 3. General Cable
 - 4. Belden Division, Cooper Industries, Inc.
 - 5. Approved equal.

2.08 INSTRUMENTATION CABLE

- A. Design. 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 on the 600-Volt Control Cable Data Sheets 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 on the 600-Volt Control Cable Data Sheets.
- B. Conductors. Provide conductors who are concentric or bunch-stranded, annealed tinned copper with physical and electrical properties conforming to ASTM B 3, ASTM B 8 or ASTM B 33 or ASTM B 174 and Part 3 of ICEA S-61-402, S-66-524, or S-68-516 unless otherwise specified on the 600-Volt Control Cable Data Sheets.

- C. Insulation. Each conductor shall be insulated as specified on the 600-Volt Control Cable Data Sheets complying to the requirements of Part 3 of ICEA S-61-402, S-66-524 or S-68-516. The average insulation thickness shall not be less than the dimensions shown in Section 3.2, Table 3-1 of ICEA S-61-402, S-66-524 or S-68-516 for 600-volt insulation unless otherwise specified on the 600-Volt Control Cable Data Sheets. The minimum insulation thickness shall not be less than 90 percent of the value given in the table.
- D. Drain Wire. Provide drain wire Class B, seven-stranded, tin-coated copper in accordance with ASTM B 3, ASTM B 8, or ASTM B 33 and as specified on the 600-Volt Control Cable Data Sheets.
- E. Shielding. Cable shielding shall consist of laminated, nonburning, mylar-backed aluminum tape applied helically around conductors with the aluminum side in continuous contact with the drain wire unless otherwise specified on the 600-Volt Control Cable Data Sheet. The tape shall be wrapped around the conductors with a 25 percent minimum overlap unless otherwise specified on the 600-Volt Control Cable Data Sheets.
- F. Jacket.
 - 1. When control cables are to be enclosed in conduit, ducts or in other raceway systems, the cables shall be of the non-metallic type and shall be covered by an overall nonmetallic jacket, as specified on the 600-Volt Control Cable Data Sheets, which complies with the requirements of Section 4.4 of ICEA S-66-524 or S-68-516, Section 4.3 of ICEA S-61-402, or Table 21-5 of Part 21 of UL 83.
 - 2. Multi-conductor cables shall have a jacket thickness which complies with Table 4-7 of Part 4 of ICEA S-66-524, Table 4-5 of Part 4 of ICEA S-68-524, or Table 4-6 of Part 4 of ICEA S-61-402 unless otherwise specified on the 600-Volt Control Cable Data Sheets.
- G. Armor. Where control cables are to be exposed, as in cable tray, cable channel or other cable support systems, the cables shall be protected by an interlocked metal tape armor made of galvanized steel which meets the requirements of paragraph 4.5 of ICEA S-68-516 or S-66-524 unless otherwise specified on the 600-Volt Control Cable Data Sheets. An over-all jacket shall be provided as specified in the Data Sheets.
- H. Conductor Identification. Identify individual conductors by method as specified on the 600-Volt Control Cable Data Sheets in conformance with Appendix L of ICEA S-66-524, Part 5 of ICEA S-68-516, or Appendix I of ICEA S-61-402.
- I. Cable Marking. Print cable marking information on the jacket of each cable at 2-foot intervals. Use a permanent printing method with a color sharply contrasting the jacket color. See the 600-Volt Control Cable Data Sheets for the minimum information required.
- J. Cables for 4-20 ma, RTD, potentiometer and similar signals intended for circuits in accordance with Article 725 of the National Electric Code shall be PLTC rated and shall be as follows:

1. Single pair cable:
 - a. Conductors: Two #16 AWG stranded, tinned, and twisted on two-inch lay
 - b. Insulation: PVC with 600-volt, 90°C rating
 - c. Shield: 100% Mylar tape with drain wire
 - d. Jacket: PVC with manufacturer's identification
 - e. UL1685 listed for underground wet location use
2. Three conductor (triad) cable:
 - a. Conductors: Three #16 AWG stranded, tinned, and twisted on two-inch lay
 - b. Insulation: PVC with 600-volt, 90°C rating
 - c. Shield: 100% Mylar tape with drain wire
 - d. Jacket: PVC with manufacturer's identification
 - e. UL1685 listed for underground wet location use
3. Multiple pair cables (where shown on the Drawings):
 - a. Conductor: Multiple pairs, #16 AWG stranded, tinned, and twisted on a two-inch lay
 - b. Insulation: PVC with 600-volt, 90°C rating
 - c. Shield: Individual pairs shielded with 100% Mylar tape and drain wire
 - d. Jacket: PVC with manufacturer's identification
 - e. UL1685 listed for underground wet location use.

2.09 COMMUNICATION CABLES

A. Cables for Ethernet and RS485 shall be rated and shall be:

1. Category 5e above Grade shielded Cable.
 - a. Conductors: Four bonded pair #24 AWG Bare Copper
 - b. Insulation: Polyolefin
 - c. Shield: 100% aluminum foil polyester tape with drain wire
 - d. Jacket: PVC with 600-volt rated and manufacturer's identification
 - e. UL21047 and UL1666 listed for indoor and dry locations use
 - f. Manufacturers
 - i. Belden 7957A
 - ii. Approved equal.
2. Category 5e above Grade un-shielded Cable
 - a. Conductors: Four bonded pair #24 AWG Bare Copper
 - b. Insulation: Polyolefin

- c. Jacket: PVC with 300-volt rated and manufacturer's identification
 - d. NEC CMR
 - e. UL1666 listed for indoor and dry locations use
 - f. Manufacturers
 - i. Belden 7923A
 - ii. [Approved] [No] equal.
3. Category 6 above Grade shielded Cable.
- a. Conductors: Four bonded pair #23 AWG Bare Copper
 - b. Insulation: Polypropylene
 - c. Shield: 100% aluminum foil polyester tape with drain wire
 - d. Jacket: PVC with 600-volt rated and manufacturer's identification
 - e. Transmission Standards: Category 6 - TIA 568.C.2
 - f. NEC CMR
 - g. Flame Test Method: UL1666 Vertical Riser listed for indoor and dry locations use
 - h. Manufacturers
 - i. Belden 7953A
 - ii. Approved equal.
4. Category 6 above Grade un-shielded Cable.
- a. Conductors: Four bonded pair #23 AWG Bare Copper
 - b. Insulation: Polyolefin
 - c. Jacket: PVC with 300-volt rated and manufacturer's identification
 - d. Transmission Standards: Category 6 - TIA 568.C.2
 - e. Nominal Velocity of Propagation: 72%
 - f. Flame Test Method: UL1666 Vertical Riser listed for indoor and dry locations use
 - g. Manufacturers
 - i. Belden 7940A
 - ii. Approved equal.
5. Category 5e below Grade shielded Cable.
- a. Conductors: Four pair #24 AWG Bare Copper
 - b. Insulation: Polyolefin
 - c. Shield: 100% aluminum foil polyester tape with drain wire

- d. Jacket: LLPE (Linear Low-Density Polyethylene) with 300-volt rated and manufacturer's identification
 - e. Misc.: NEMA WC-63.1, listed for outdoor and wet locations use
 - f. Water Blocking compound and listed for direct bury applications.
 - g. Manufacturers
 - i. Belden 7937A
 - ii. Black Box
 - iii. Approved equal.
6. Category 5e below Grade unshielded Cable
- a. Conductors: Four pair #24 AWG Bare Copper
 - b. Insulation: Polyolefin
 - c. Jacket: LLPE (Linear Low-Density Polyethylene) with 300-volt rated and manufacturer's identification
 - d. Misc.: NEMA WC-63.1, listed for outdoor and wet locations use.
 - e. TIA-568-C.2 Category 5e compliance
 - f. Water Blocking compound and listed for direct bury applications.
 - g. Manufacturers
 - i. Belden 7934A
 - ii. CommScope Ultra II 5NF4
 - iii. Approved equal.
7. Category 6 below Grade Cable
- a. Conductors: 4 pair 23AWG Bare Copper
 - b. Insulation: Polyolefin
 - c. Shield: 100 percent aluminum foil polyester tape with drain wire
 - d. Jacket: Polyethylene with 300 volts rated and manufacturer's identification
 - e. Misc.: Gel filled and NEMA WC-63.1, listed for outdoor and wet locations use
 - f. Manufacturers:
 - i. CommScope SYSTIMAX GigaSPEED X10D 1571
 - ii. Approved equal.
8. 485 Communications Cable
- a. Conductors: One pair #24 AWG Tinned Copper
 - b. Insulation: Polyethylene

- c. Shield: 100% aluminum foil polyester tape with tinned copper drain wire
- d. Jacket: PVC with 300-volt rated and manufacturer's identification
- e. Misc.: UL2919 listed for indoor and dry locations use
- f. Manufacturers
 - i. Belden 9841
 - ii. Approved equal.

B. Color code for Ethernet communications cables shall be as follows.

- 1. Green – CAT5e Phone / Data
- 2. Red – CAT5e SCADA
- 3. Blue – CAT6 – Phone / Data
- 4. White – CAT6 – SCADA
- 5. Green – Phone / Data
- 6. Red – FIRE Alarm
- 7. Blue – SCADA
- 8. Green – Phone
- 9. Red – FIRE / Security
- 10. Blue – Administrative Network
- 11. Yellow – SCADA

2.10 TERMINATION MATERIALS

- A. Power Conductors: Termination materials, of conductors at equipment, shall be as specified in the relevant equipment Section.
- B. Control and Instrumentation Conductors (including graphic panel, alarm, low- and high-level signals): Termination connectors shall be DIN-rail-mounted one-piece molded plastic blocks with tubular-clamp-screw type, with end barriers, dual side terminal block numbers and terminal group identifiers. Terminals to be UL Listed for stranded conductor terminations. Rated for a maximum of 2 #14 stranded conductors. Color of terminals to comply with NFPA 79.
- C. Manufacturers
 - 1. Phoenix Contact
 - 2. Entrelec
 - 3. Weidmuller
 - 4. Allen Bradley
 - 5. Approved equal.
- D. Motor Conductors: Motor connections with conductors #12 AWG up to #6 AWG shall be ring type compression terminations on the motor leads and secured with

bolt, nut and spring washer. Connections shall be -30°C rubber insulated, half lap, and two layers minimum of Scotch 33 or equal vinyl tape. Motor terminations for conductors #8 AWG and larger shall be in accordance with paragraph "Lugs and Connectors" below. Motors provided on this project per specification 16150 and / or 16151 shall have motor terminals enclosures with bus and NEMA one-hole or two-hole pads to accommodate the conductor terminals specified herein.

E. Lugs and Connectors

1. All lugs and connectors shall be tin plated copper and shall be crimped type, installed with standard industry tooling. Lugs, where specified to be used, and connectors shall all match the wire size and shall be clearly identified, and color coded on the connector. All connections shall be made for stranded wire and shall be made electrically and mechanically secured. The lugs and connectors shall have a current carrying capacity equal to the conductors for which they are rated and meet UL 486 requirements for 75°C. Lugs for #12 AWG up to #6 AWG shall be ring terminals. Conductors #4 AWG and larger shall be two-hole long barrel lugs with NEMA spacing. All lugs shall be the closed end construction to exclude moisture migration into the cable conductor.

2.11 SPLICE MATERIALS

- A. Power Conductors: Circuits shall be pulled from terminal to terminal, without splicing, except where splicing is shown on the Drawings. No other splicing will be permitted. For wires sizes #8 AWG and smaller, provide color coded wire nuts, with metal inserts, 3M or Ideal, rubber insulated with half lap and two layers minimum of Scotch 33 tape. For wires greater than #8 AWG, provide a heat shrink insulated, color-coded, die-crimped splice lug, T&B 54XXX, rubber insulated, with half lap and two layers minimum of Scotch 33 tape.
- B. Control and Instrumentation Conductors (including graphic panel-, alarm-, low- and high-level signals): No splicing of control and instrumentation conductors will be permitted.

2.12 WALL AND FLOOR SLAB OPENING SEALS

- A. Wall and floor slab openings shall be sealed with "FLAME-SAFE" as manufactured by the Thomas & Betts Corp.

2.13 WIRE AND CABLE TAGS

- A. Use the tagging formats for wire and cable as shown on the Drawings. Where modifications or additions are made to existing wire and cable runs, replace existing tags with new modified tags.
- B. Wire tags for wire sizes, #2 AWG and smaller, shall be heat shrink type Raychem TMS-SCE, or equal with the tag numbers typed with an indelible marking process. Character size shall be a minimum of 1/8-inch in height. Hand-written tags shall not be acceptable. Where ends are not available, attach cable tags with nylon tie cord.
- C. Tags for wires larger than #2 AWG and all cables shall be thermally printed polyethylene type, Brady TLS 2200 or equal, nylon zip tied in accordance with the manufacturer's instructions.

- D. Tags relying on adhesives or taped-on markers are not acceptable.
- E. Tagging shall be done in accordance with the execution portion of these Specifications.

2.14 WIRE COLOR CODE

- A. All wire shall be color coded or coded using electrical tape in sizes #8 or greater, where colored insulation is not available. Where tape is used as the identification system, it shall be applied in all junction boxes, manholes and other accessible intermediate locations as well as at each termination.

- B. The following coding shall be used:

<u>System</u>	<u>Wire</u>	<u>Color</u>
1-Phase, 3 Wire	Phase A	Black
	Phase B	Blue
	Neutral	White
208Y/120, Volts 3-Phase, 4 Wire	Phase A	Black
	Phase B	Red
	Phase C	Blue
	Neutral	White
240/120, Volts 3-Phase, 4 Wire	Phase A	Black
	Phase B	Orange
	Phase C	Blue
	Neutral	White
480/277, Volts 3-Phase, 4 Wire	Phase A	Brown
	Phase B	Purple
	Phase C	Yellow
	Neutral	Gray
Motor Control	1	Black
	2	Red
	3	Blue

2.15 CABLE TAG COLOR CODE

- A. All cable tags shall be white in color with black printing.

PART 3 EXECUTION

3.01 GENERAL

- A. Do not install conductors until the raceway system is in place. No conductor shall be installed between outlet points, junction points or splicing points, until raceway sections have been completed, and raceway covers are installed for protection of conductors from damage or exposure to the elements. Any conductor installed in an incomplete raceway system shall be removed from the raceway system and from project site. A complete inspection of such raceway sections shall be completed before new conductors are installed.
- B. Installed unapproved wire shall be removed and replaced at no additional cost to the Owner.
- C. Completely swab raceway system before installing conductors. Do not use cleaning agents and lubricants which have a deleterious effect on the conductors or their insulation.
- D. Pull all conductors into a raceway at one time, using wire pulling lubricant as needed to protect the wire.
- E. Except for hand-pulled conductors into raceways, all wire and cable installation shall be installed with tension-monitoring equipment. Conductors which are found to have been installed without tension-monitoring shall be immediately removed from the raceways, permanently identified as rejected material, and removed from the jobsite. New conductors and cables shall be reinstalled, tagged and raceways resealed, with no change in the Contract Price or Schedule allowed.
- F. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii. Where pulling compound is used, use only UL listed compound compatible with the cable outer jacket and with the raceway involved.
- G. Tighten all screws and terminal bolts using torque type wrenches and/or drivers to tighten to the inch-pound requirements of the NEC and UL.
- H. Single conductors and cables in manholes, hand holes, vaults, cable trays, and other indicated locations are not wrapped together by some other means such as arc and fireproofing tapes, shall be bundled throughout their exposed length with nylon, self-locking, releasable, cable ties placed at intervals not exceeding four inches on centers.
- I. All wire and cable installed in cable trays shall be UL Listed as Type TC, for cable tray use.

3.02 CONDUCTORS 1000 VOLTS AND BELOW

- A. Provide conductor sizes indicated on Drawings, as a minimum.
- B. Use crimp connectors on all stranded conductors.
- C. Soldered mechanical joints insulated with tape will not be acceptable.

- D. Arrange wiring in cabinets and panels neatly cut to proper length. Surplus wire shall be removed unless noted otherwise. Conductors shall be bridled or bundled and secured in an acceptable manner. Identify all circuits entering motor control centers and all other control enclosures in accordance with the conductor identification system specified herein.
- E. Terminate control and instrumentation wiring with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
- F. Attach compression lugs, larger than #6 AWG, with a tool specifically designed for that purpose which provides a complete, controlled crimp where the tool will not release until the crimp is complete. Use of plier type crimpers is not acceptable.
- G. Cap spare conductors and conductors not terminated with the UL listed end caps.
- H. Remove all burrs, chamfer all edges, and install bushings and protective strips of insulating material to protect the conductors passing through holes or over edges in sheet metal enclosures.
- I. Provide at least 6 feet spare conductors in freestanding panels and at least two feet spare in other assemblies for all conductors which are to be terminated by others. Provide additional conductor length in any assembly where it is obvious that more conductor will be needed to reach the termination point.
- J. Do not combine power conductors in the same raceway unless shown on Drawings. Do not run signal conductors carrying voltages less than 120 volts AC in the same raceway as conductors carrying higher voltages regardless of the insulation rating of the conductors. Do not share neutrals on branch circuits.
- K. Install medium voltage (5 kV and 15 kV) and 600V cables in separate trays.

3.03 GROUNDING

- A. Conduits and other raceways shall contain an equipment grounding conductor whether the raceway is metallic or not. Conduits, motors, cabinets, outlets, and other equipment shall be properly grounded in accordance with NEC requirements and specification 16660. Ground wires exposed to mechanical damage shall be installed in rigid aluminum conduit. Make connections to equipment with solderless connections. Connections to ground rods shall be of the fused type equal to the Cadweld process.

3.04 TERMINATIONS AND SPLICES

- A. No splices of wire and cable will be permitted, except where specifically permitted by the Owner/Engineer in writing, or as shown on the Drawings.
- B. Power conductors: Terminations shall be made with connectors as specified. Splices, where specifically allowed as stated above, shall be made in a Termination Cabinet (TC).
- C. Control Conductors: Splices of control conductors will not be permitted between terminal points. Terminations shall be made with approved terminals as specified.

- D. Instrumentation Signal Conductors (including graphic panel-, alarm-, low- and high-level signals): Splices of Instrumentation conductors will not be permitted between terminal points. Terminations shall be made with connectors as specified. The shield of pair shielded, and triad shielded shall be terminated on terminal strips. Provide dedicated terminal block to every conductor including shields. Double lugging terminations is not acceptable.

3.05 INSTRUMENTATION CABLES

- A. Instrumentation cables shall be installed in raceways as specified. Unless specifically shown on the Drawings, all instrumentation circuits shall be installed as single shielded twisted pair cables or single shielded twisted triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required.
- B. Terminal blocks shall be provided at all instrument cable junction boxes, and all circuits shall be identified at such junctions.
- C. Shielded instrumentation wire, coaxial cable, data highway cable, discrete I/O, multiple conductor cable, and fiber optic cables shall be run without splices between instruments, terminal boxes, or panels. The shield shall be continuous for the entire run.
- D. Shields shall be grounded at the PLC/RTU. Terminal blocks shall be provided for inter-connecting shield drain wires at all junction boxes. Individual circuit shielding shall be provided with its own block.
- E. Shield wire shall be wrapped and taped at the transmitter end of the signal run. Before termination, peel back the outer sheath, leaving the shield intact. Wrap the drain wire around the conductors, leaving approximately two inches exposed. Wrap the drain wire with two layers of Scotch 33 tape.
- F. Cable in Tray
 - 1. Install armored cable in cable tray.
 - 2. 600-Volt Tray rated Control Cable may be installed in cable tray with 600-volt Tray rated power cables provided a barrier between signal and power cables are installed.
 - 3. Install cables in trays in a neat and orderly manner. Tie cables to the rungs at approximate 15-foot intervals by use of cable ties.

3.06 WIRE TAGGING

- A. All wiring shall be tagged at all termination points and at all major access points in the electrical raceways. A termination point is defined as any point or junction where a wire or cable is physically connected. This includes terminal blocks and device terminals. A major access point to a raceway is defined as any enclosure; box or space designed for wire or cable pulling or inspection and includes pull boxes, manholes, and junction boxes.

- B. Wire tags shall show both origination and destination information to allow for a wire or cable to be traced from point in the field. Information regarding its origination shall be shown in parenthesis.
- C. For multiconductor cables, both the individual conductors and the overall cable shall be tagged. Conductors that are part of a multiconductor cable shall reference the cable identification number that they are a part of, as well as a unique conductor number within the cable.

3.07 CABLE TAGGING

- A. All cables shall be tagged at all termination points and at all major access points in the electrical raceways as defined in the wire tag section of this Specification.
- B. The cable tag shall be installed where the cable enters and leaves each access point (e.g., junction box, manhole, etc.). In cases of limited access space, a single tag may be used that shows both equipment tag origination and destination. In the case where the jacket is stripped for terminations, the tag shall be installed at the end of the jacket.

3.08 RACEWAY SEALING

- A. Raceways entering junction boxes or control panels containing electrical or instrumentation equipment shall be sealed with 3M 1000NS Watertight Sealant or equal.
- B. This requirement shall apply to for all raceways in the conduit system.

3.09 FIELD TESTS

- A. Conductors under 600 volts
 - 1. Perform insulation resistance testing of all power circuits below 1000 volts with a 1000-volt megger, in accordance with the recommendations of the wire manufacturer.
 - 2. Prepare a written test report of the results and submit to the Owner/Engineer prior to final inspection.
 - 3. Minimum acceptable value for insulation resistance is 100 megohms. Lower values shall be acceptable only by the Owner/Engineer's specific written approval.
 - 4. Disconnect equipment that might be damaged by this test. Perform tests with all other equipment connected to the circuit.
- B. Tests: After instrumentation cable installation and conductor termination by the instrumentation and control supplier, perform tests to ensure that instrumentation cable shields are isolated from ground, except at the grounding point in the instrumentation control panel. Remove all improper grounds.

END OF SECTION

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SECTION 16140

LIGHT SWITCHES AND RECEPTACLES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and install wiring devices as shown on the Drawings and as specified herein.
- B. Provide all interconnecting conduit and branch circuit wiring for receptacle circuits in accordance with the NEC.

1.02 RELATED WORK

- A. Refer to Division 16000 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

- A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 16000, the following:
 - 1. Manufacturers' names and product designation or catalog numbers of all materials specified.
 - 2. Cut sheets for each individual item shall be submitted.
 - 3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.
 - 4. Submit catalog data of all switches, receptacles, and other specified items under this Section, with all options, application locations and exceptions clearly indicated. All cut sheets shall be clearly marked to indicate which products are being submitted for use on this project. Unmarked cut sheets will be rejected and returned for revision.

1.04 REFERENCE STANDARDS

- A. Wiring devices shall comply with the requirements of the National Electrical Code (NEC) and shall be Underwriters Laboratories (UL) labeled.
- B. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA):
 - 1. NEMA WD1 - General Purpose Wiring Devices.
 - 2. NEMA WD6 - Dimensional Requirements.
- C. Federal Specifications (WC-596F).
 - 1. American National Standards Institute/National Fire Protection Association (NFPA):

- D. NFPA No. 70 - National Electrical Code (NEC), Articles 210 Branch Circuits, 250 Grounding and 410, Paragraphs 56, 57 and 58.

1.05 QUALITY ASSURANCE

- A. The manufacturer of these materials shall have produced similar electrical materials and equipment for a minimum period of five years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- B. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly. All assemblies shall be of the same manufacturer.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

- A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, or equipment which failed any factory tests, will not be permitted.
- B. Equipment shall be handled and stored in accordance with manufacturer's instructions.
- C. Equipment shall be stored indoors and protected from moisture, dust and other contaminants.
- D. Equipment shall not be installed until the location is finished and protected from the elements.

1.07 WARRANTY

- A. Provide warranties, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

1.08 MEASUREMENT AND PAYMENT

- A. Refer to Section 16000.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the Manufacturers listed in each product category are acceptable.
- B. The listing of specific manufacturers does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed are not relieved from meeting these specifications in their entirety.

2.02 RATINGS

- A. The service voltage shall be as shown on the Drawings. The overall short circuit withstand, and interrupting rating of the equipment and devices shall be equal to or greater than the overall short circuit withstand and interrupting rating of the feeder device immediately upstream of the equipment.

2.03 MATERIALS

- A. Wall switches shall be heavy duty, industrial specification grade, toggle action, flush mounting quiet type. All switches shall conform to the latest revision of Federal Specification WS 896.
 - 1. Manufacturer
 - a. Eaton
 - b. Hubbell, Inc.
 - c. Pass & Seymour, Inc.
 - d. Bryant Electric
 - e. Leviton Manufacturing Company
 - f. No equal.
 - 2. Single pole, 20 Amp, 120/277 Volt – (Cooper 2221V)
 - 3. Double pole, 20 Amp, 120/277 Volt – (Cooper. 2222V)
 - 4. Three-way, 20 Amp, 120/277 Volt – (Cooper 2223V)
 - 5. Four-way, 20 Amp, 120/277 Volt – (Cooper 2224V)
 - 6. Single pole, 20 Amp, 120/277 Volt - key operated - (Cooper AH1191N)
 - 7. Single pole, 20 Amp, 120 Volt - red pilot-lighted handle – (Cooper 2221PL)
 - 8. Single pole, 20 Amp, 120 Volt, clear lighted handle – (Cooper 2221LTV)
 - 9. Momentary contact, three position, 2 circuit, center off – (Cooper 1995V)
- B. Fluorescent wall box dimmer switch for 120/277 Volt control of rapid start fluorescent lamps with a dimming range of 100% to 0.5% light for 120-volt and 100% to 1% light for 277-volt.
 - 1. Manufacturers
 - a. Lutron Electronics Co., Inc.
 - b. Lithonia Control Systems
 - c. Valmont Electric, Inc.
- C. Explosion proof single pole factory sealed switches shall be for 20 Amps, 120/277 volts, mounted in copper free aluminum boxes.
 - 1. Manufacturers
 - a. Eaton

- b. Appleton Electric Co.
- c. Killark
- D. Receptacles shall be heavy duty, corrosion resistant, specification grade of the following types and manufacturer or equal. Receptacles shall conform to Fed Spec WC596.
 - 1. Manufacturers
 - a. Eaton
 - b. Hubbell, Inc.
 - c. Pass & Seymour, Inc.
 - 2. Duplex, 20 Amp, 125 Volt, 2 Pole, 3 Wire Grounding, high impact, arc and moisture resistant yellow nylon construction, heavy nickel plating on metal parts;
 - 3. Single, 20 Amp, 250 Volt, 2 Pole, 3 Wire.
 - 4. GFI or GFCI (ground fault circuit interrupter) receptacles:
 - a. Provide feed-through type with test and reset button. GFCI must be self-testing per NEC.
 - b. Provide 5 milliamp ground fault trip for personnel protection.
 - c. Provide 30 milliamp ground fault trip for equipment protection
- E. Weatherproof covers
 - 1. Die cast aluminum. Plastic or other non-metallic in-use covers are not acceptable.
 - 2. Weatherproof while-in-use rating
 - 3. Manufacturers
 - a. Eaton
 - b. Thomas & Betts
 - c. Approved No equal.
- F. Special purpose
 - 1. Manufacturers
 - a. Eaton
 - b. Hubbell
 - c. Pass & Seymour
 - 2. Clock hanger single, 15 Amp, 125 Volt, 2 Pole, 3 Wire, with hanging hook on device plate.
 - 3. Single, corrosion resistant locking, 20 Amp, 125 Volt, 2 Pole, 3 Wire; Cooper, Catalog No. CRL520R and plug
 - 4. Single twist-lock, 30 Amp, 125 Volt, 1 Phase, 3 Wire; Cooper, Catalog No. CRL530R; plug.

5. Single twist-lock, 20 Amp, 250 Volt, 1 Phase, 3 Wire.
6. Single twist-lock, 30 Amp, 250 Volt, 1 Phase, 3 Wire.
- G. Explosion-proof receptacles and plugs
 1. Manufacturers
 - a. Appleton Electric
 - b. Eaton
 - c. Hubbell Inc.
 2. Single, 20 Amp, 125 Volt, 1 Phase, 3 Wire
 3. Duplex, 20 Amp, 125 Volt, 1 Phase, 3 Wire.
 4. Single, 20 Amp, 250 Volt, 1 Phase, 3 Wire
 5. Duplex, 20 Amp, 250 Volt, 1 Phase, 3 Wire.
- H. Device Plates
 1. Plates for indoor flush mounted devices shall be of the required number of gangs for the application involved and shall be as follows:
 - a. Administration type buildings: Smooth, high impact nylon of the same manufacturer and color as the device. Final color to be as selected by the Architect.
 - b. Where permitted in other areas of the plant, flush mounted devices in cement block construction shall be Type 302 high nickel (18-8) stainless steel of the same manufacturer as the devices.
 2. Plates for indoor surface mounted device boxes shall be cast metal of the same material as the box.
 3. Oversized plates shall be installed where standard plates do not fully cover the wall opening.
 4. Device plates for switches mounted outdoors or indicated as weatherproof shall be gasketed, cast aluminum with provisions for padlocking switches "On" and "Off",
 5. Multiple surface mounted devices shall be ganged in a single, common box and provided with an adapter, if necessary, to allow mounting of single gang device plates on multi-gang cast boxes.
 6. Engraved device plates shall be provided where required.
 7. Weatherproof, gasketed cover for GFI receptacle mounted in a FS/FD box
 - a. Manufacturers
 - i. Eaton,
 - ii. Hubbell, Inc.
 - iii. Pass & Seymour, Inc.

I. Three Phase Power Receptacles

1. Three phase power receptacles and plugs shall be rated for the voltage and current ratings of the connected load unless otherwise shown on the Drawings.
2. Receptacles and plug housings shall be constructed of copper free aluminum listed to UL standard 498 for watertight construction. Hardware shall be stainless steel.
3. Performance
 - a. Maximum working voltage: 600 volts RMS.
 - b. Dielectric withstand voltage: 3000 volts.
 - c. Full load break capability at rated current.
 - d. 5000 connect/disconnect cycles at rated voltage and current.
4. Furnish and install one mating plug with each receptacle.
5. Provide the following features:
 - a. Color coded by voltage.
 - b. One-piece housing/angled back box
 - c. Shrouded pins
 - d. Self-closing gasketed cover.
 - e. Watertight cable entrances/stress relief grips.
 - f. Mating keys.
 - g. All current carrying components shall be tin plated including contacts.
 - h. Conductor clamping screws shall be stainless steel.
6. Acceptable manufacturers:
 - a. Hubbell (North American Rated Series II)
 - b. ABB
 - c. Cooper
 - d. Meltric

J. Interlocked Three Phase Power Receptacles

1. Interlocked three phase power receptacles shall include a combination receptacle and a mechanically interlocked disconnect switch. The two units shall be interlocked to prevent removal or insertion of the plug unless the switch is in the OFF position. The receptacle shall meet the requirements of Power Receptacles specified herein.
2. Provide a matching plug for every unit furnished.
3. Switch, power receptacle and mating plug shall be constructed of copper free aluminum.

4. Assembly shall be listed to UL Standard 498 for watertight- construction.
 5. Hardware shall be stainless steel.
 6. Performance:
 - a. Maximum working voltage: 600 volts RMS.
 - b. Dielectric withstand voltage: 3000 volts.
 - c. Full load break capability at rated current.
 - d. 5000 connect/disconnect cycles at rated voltage and current.
 7. Provide the following features:
 - a. Color coded by voltage.
 - b. One-piece housing/angled back box
 - c. Shrouded pins
 - d. Self-closing gasketed cover.
 - e. Watertight cable entrances/stress relief grips.
 - f. Mating keys.
 - g. All current carrying components shall be tin plated including contacts.]
 - h. Conductor clamping screws shall be stainless steel.
 8. The disconnect switch shall be unfused or fused, as shown on the Drawings, or otherwise specified herein or if required by the NEC, with ratings as hereinbefore specified. Provide lockout provisions on the disconnect switch handle.
 9. Manufacturers
 - a. Crouse-Hinds
 - b. Appleton
 - c. Killark
 - d. Hubbell
- K. 30 Amp, 480-volt Receptacles
1. 30 Amp, 480-Volt receptacles shall be 3 Pole, 4 Wire, grounding pin and sleeve type, with circuit breaking capability. The receptacle shall meet the requirements of Power Receptacles specified herein.
 2. Manufacturers
 - a. Crouse Hinds Arktite style 2, Catalog No. ARE 3423
 - b. Approved equal.
 3. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

4. All current carrying components shall be tin plated including contacts.
 5. Conductor clamping screws shall be stainless steel.
 6. Furnish and install one matching plug for each receptacle shown on the Drawings.
- L. Welding Receptacles and Disconnect Switches
1. Manufacturers
 - a. Crouse Hinds Arktite Receptacles with Enclosed Safety Switches", Catalog No. WSR103542.
 - b. Approved equal.
 2. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
 3. Welding receptacles and disconnect switches shall be rated 600 Volts, 100 Amp, 3-pole, 4-wire, 60 Hz. Receptacle shall be mechanically interlocked with its disconnect switch to prevent breaking the circuit with the receptacle and plug. Ground wire shall be bonded to the plug and receptacle housings. Enclosure type shall be NEMA 4. The receptacle shall meet the requirements of Power Receptacles specified herein.
 - a. All current carrying components shall be tin plated including contacts.
 - b. Conductor clamping screws shall be stainless steel.
 4. Furnish and install one matching plug for the welder.
- M. Portable Generator Input Receptacle
1. Portable generator input receptacle shall be weatherproof, rated for 600 Volts, 100 Amp, 3 Phase, 4 Wire grounding pin and sleeve type with a 15 degree mounting adapter, spring door cover.
 2. Manufacturers
 - a. Eaton
 - b. Approved equal.
 3. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
 4. All current carrying components shall be tin plated including contacts.
 5. Conductor clamping screws shall be stainless steel.
 6. Both receptacle and plug shall have reversed contacts.

N. Poke-Through Service Fittings

1. Poke-through service fittings shall be installed in a two-inch core drilled hole, fit floor thicknesses of 2-1/2 inches to 7 inches and be fire rated.
2. Poke-through service fittings shall be provided with barriers to handle both high- and low-tension services and be designed for both new construction and building retrofit.
3. Service fitting heads shall each contain a 20 Amp, 125-volt, 2-pole, 3-wire duplex receptacle on one side and provisions for up to two-25 pair telephone cables on the remaining side.
4. Manufacturers
 - a. Raceway Components
 - b. Walker
 - c. Schneider Electric Co
 - d. Approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Switches and receptacles shall be installed flush with the finished wall surfaces in areas with stud frame and gypsum board construction, in dry areas with cement block construction or when raceways are shown as concealed on the Drawings.
- B. Do not install flush mounted devices in areas designated DAMP, WET or WET/CORROSIVE on the Drawings. Provide surface mounted devices in these areas.
- C. Provide weatherproof devices covers in areas designated WET or WET/CORROSIVE on the Drawings.
- D. Unless otherwise shown on the Drawings, wall switches and other wall mounted controls shall be installed at 54 inches AFF.
- E. Convenience receptacles shall be 36 inches above the floor unless otherwise shown.
- F. Convenience receptacles installed outdoors and in rooms where equipment may be hosed down shall be 36 inches above floor or grade. Switches shall be ganged together under one cover plate.
- G. The location of all devices is shown, in general, on the Drawings and may be varied within reasonable limits to avoid any piping or other obstruction without extra cost, subject to the approval of the Owner. Coordinate the installation of the devices for piping and equipment clearance.
- H. Convenience receptacles and light switches shall be connected using stranded pig tails and spring fork insulated lugs. Feed-through wiring of receptacles is prohibited.

3.02 FIELD QUALITY CONTROL

- A. Test wiring devices to ensure electrical continuity of grounding. Energize the circuit to demonstrate compliance with the requirements.

END OF SECTION

SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install a complete Electrical Identification System, as shown on the drawings and specified herein.
- B. Specification as a minimum shall include for electrical identification including:
 - 1. Nameplates and labels
 - 2. Wire and cable markers
 - 3. Conduit markers
 - 4. Cable tray markers
 - 5. Underground warning tape
 - 6. Warning labels

1.02 RELATED WORK

- A. Refer to Section 16000 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

- A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 16000, the manufacturers' names and product designation or catalog numbers of all materials specified.
- B. Cut sheets for each individual item shall be submitted. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.
- C. Submit the following under the provisions of Section 01330 Submittal Procedure:
 - 1. Manufacturer's cut sheets and catalog data
 - 2. Description of materials used
 - 3. Label or nameplate dimensions
 - 4. Engraving or imprint legends
 - 5. Instruction for handling and storage
 - 6. Installation instructions

1.04 REFERENCE CODES AND STANDARDS

- A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - 1. No. 70 - National Electrical Code (NEC)
 - a. Article 110 - Requirements for Electrical Installation
 - b. Article 430 - Transformers and Transformer Vaults
- B. City of Houston Electrical Code
- C. Other applicable Codes and Standards as referenced in other Sections.
- D. Underwriters Laboratories. U.L. Standards No. 224 - Extruded Insulated Tubing

1.05 JOB SITE DELIVERY, STORAGE AND HANDLING

- A. Pack materials to permit ease of handling and to provide protection from damage during shipping, handling, and storage.

1.06 MEASUREMENT AND PAYMENT

- A. Refer to Section 16000.

1.07 WARRANTY

- A. Provide warranties, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Almetek Industries Incorporated
- B. Brady U.S.A. Incorporated
- C. Ideal Electric Company
- D. Raychem Corporation
- E. 3M Electrical Products Division
- F. Thomas & Bett
- G. HellermannTyton

2.02 MATERIALS AND EQUIPMENT

A. Nameplates and Labels

1. Provide an identification tag for each item of electrical and instrumentation equipment showing its item number and service or application. Use the description shown on the electrical Drawings.
2. For nameplates, use 3-ply phenolic material engraved to show black lettering on a white background. Size the nameplates approximately 1 inch wide and 3 inches long for 3 lines of 3/16 inch - 16 letters with a 0.8 condensed factor.
3. Generally, provide large pieces of equipment with engraved nameplates; provide additional nameplates at pushbuttons and other local devices; as detailed. Provide identification for all other electrical and instrumentation equipment, devices, or enclosures, such as MCC's, panelboards, disconnect switches, capacitors, relays, and dedicated receptacles not furnished with readily noticeable tag, nameplates, or other means of identification. Provide fault current nameplate per NEC requirements.
4. Install nameplates on the front cover of transformers stating the transformer service location number or identification number, the panelboard or device served, and main breaker feeding the transformer (MCC No. and compartment), and the drawing number on which the transformer schematic is shown.
5. Furnish equipment, such as motor starters, safety switches, welding receptacles and circuit breakers, with 1" x 3" plastic nameplates stating description of item served.
6. Provide nameplates for motors giving the driven equipment description, the service location number, and the MCC number with compartment number when applicable. Nameplates will normally be mounted adjacent to the motor at the motor pushbutton when one is furnished.
7. Install nameplates on the outside and inside of doors to circuit breaker panelboards (i.e., lighting, instrument, or receptacle panels). State the panelboard name, the drawing number on which the panelboard schedule shows, and the main breaker feeding the panel (MCC No. and compartment).
8. Type panelboard directories and insert them inside the panelboard doors. Text shall be 12pt- Arial font.
9. Place a large nameplate no less than 3"x5" on control panels, relay panels, junction boxes, or enclosures with electrical devices mounted inside or on the outside of the enclosure indicating the purpose of the cabinet.
10. Provide a nameplate on MCC motor starter doors duplicating motor nameplate data.

B. Wire and Cable Markers

1. Use pre-printed tubular heat-shrink type wire and cable markers at each end of all conductors.

2. Select markers manufactured so that the heat-shrink process makes the imprint permanent and solvent-resistant.
 3. Use markers that are self-extinguishing, conforming to U.L. Standard No. 224 for print performance, heat shock, and flammability.
 4. Provide marker material that is flexible, radiation cross-linked polyolefin with 3 to 1 shrink ratio, rated 600 volts, and white in color.
- C. Conduit Markers
1. Provide conduit markers made of 19 gauge stainless steel tags approximately 2 inches x 1 inch.
 2. Stamp the caption on the tag and have it black filled.
 3. Punch tags for tie fasteners. Fasten tags to the conduits with stainless steel braided wire. Nylon tie-wraps are not acceptable.
 4. As manufactured by Panduit Corp. or equal.
- D. Cable Tray Markers
1. For high visibility and contrast, use cable tray markers that are yellow with black legend.
 2. Use markers made of vinyl impregnated cloth, suitable for exposure to corrosive, wet, and abrasive environments.
 3. Make markers of pre-cut individual letters or numbers with pressure sensitive adhesive backing.
 4. Size legend characters to 4 inches high on a total marker height of approximately 5 inches, suitable for applying to 6-inch side rails of a cable tray.
- E. Underground Warning Tape
1. Provide warning tape made of 4 mil thick polyolefin film, 3 inches wide, suitable for direct burial and resistant to alkalis, acids, and other common soil substances.
 2. Use red tape with black legend printed in permanent ink.
- F. Warning Labels
1. Place OSHA safety labels on enclosures and boxes 100 cubic inches or more containing electrical equipment or terminations.
 2. Provide OSHA color codes for the labels. Use labels made from 4 mil vinyl with pressure sensitive adhesive backing.
 3. The warning label caption is DANGER - 480 VOLTS or as indicated on the drawings
 4. Size labels either 5 inches x 3-1/2 inches or 10 inches x 7 inches, as indicated on the Drawings.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces where adhesive labels will be applied.
- B. Drill holes for nameplates to be fastened with stainless screws.
- C. Prepare the cable ends for termination and conductor markings.
- D. Identify conduits at terminating points and select tags accordingly.

3.02 INSTALLATION

- A. Install nameplates and labels in accordance with the manufacturer's instructions and the Drawings.
- B. Apply wire and cable markers in accordance with manufacturer's instructions using a heat gun with properly sized nozzle for the application. Tag the wires at both ends with the same notation.
- C. Tag conduits at junction boxes, pull boxes, and at other termination points.
- D. Identify cable trays at the time of installation with the alphanumeric number shown on the Drawings. Label cable trays on the outside rail. Place the tray identifier at each point where the tray designation changes and at 200 foot intervals in between, but not less than two per run.
- E. Identify underground conduits, cables, or duct banks using the underground warning tape. Also use underground warning tape for the underground grounding grid, including the laterals. Install one tape per trench at 12 inches below grade or as indicated on the Drawings. For wide trenches or duct banks, install one warning tape per 24 inch width.
- F. Apply the 5 inches by 3-1/2 inches warning labels to disconnect switches, panelboards, terminal boxes, and similar devices in accordance with manufacturer's instruction and the Drawings. Apply the 10 inches x 7 inches warning labels to larger control panel enclosures, motor control centers, and to entrance doors to buildings containing electrical power and control equipment.

END OF SECTION

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SECTION 16196

LOW VOLTAGE AC SURGE PROTECTIVE DEVICES (SPD's)

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. All equipment described herein shall be submitted, and factory installed, as an integral part of equipment specified elsewhere in these Specifications.
- B. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install surge protective devices (SPDs) in the MCC/power panel, control panels and field devices.
- C. Provide surge protection devices to protect field instruments and equipment from the effects of transient surges caused by lightning and other electrical sources.
- D. SPDs shall be installed at the following locations:
 - 1. On 480 VAC power and neutral connections at the MCC or power panels.
 - 2. On 120 VAC, 60Hz power connections to control panels.
 - 3. On all analog signals at the control panel. Include surge protection at 24 VDC loop powered field instruments for wiring distances greater than 75 feet from the control panel. Include surge protection on all four-wire, 120 VAC field instruments.
 - 4. On all discrete signals that have portions of interconnecting wiring located outside of protected buildings.
 - 5. On all copper data lines that have portions of interconnecting wiring located outside of protected buildings.

1.02 RELATED WORK

- A. Refer to Division 16000 for related work and electrical coordination requirements.

1.03 MEASUREMENT AND PAYMENT

A. UNIT PRICES

- 1. This item will be measured and paid for as a lump sum for each lift station site.
- 2. Payment will be full compensation for all labor, equipment, materials and supervision for the demolition, cleanup and other related work necessary for construction as shown on the drawings and specified herein.
- 3. Refer to Section 01270 – Measurement and Payment for unit price procedures.

1.04 SUBMITTALS

- A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 16000, the following:
 - 1. Manufacturers' names and product designation or catalog numbers of all materials specified.

2. Cut sheets for each individual item shall be submitted.
3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.
- B. Submittals for equipment specified herein shall be made as a part of equipment furnished under other Sections. Individual submittals for equipment specified herein will not be accepted and will be returned unreviewed. Unmarked cut sheets will cause rejection of the submittal and its return for revision.
- C. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will be returned unreviewed.
- D. Submit catalog data for all items supplied from this specification Section as applicable. Submittal shall include catalog data, functions, ratings, inputs, outputs, displays, etc., enough to confirm that the SPD provides every specified requirement. Any options or exceptions shall be clearly indicated, with the reason for such deviations. Acceptance of any deviation will be at the sole discretion of the Owner/Engineer. Shop drawings, not so checked and noted, will be returned unreviewed.
- E. The submittals shall include:
 1. Dimensional drawing of each SPD type.
 2. UL 1449 Third Edition Listing, Standard for Safety, Surge Protective Devices, documentation. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL).
 3. UL 1283 Listing, Electromagnetic Interference Filters, documentation.
 4. ANSI/IEEE C6241 and C6245, Category C3 (20kV-1.2/50, 10kA-8/20μs waveform) clamping voltage test results.
- F. Operation and Maintenance Manuals.
 1. Operation and Maintenance manuals shall include the following information:
 - a. Manufacturer's contact address and telephone number for parts and service.
 - b. Instruction books and/or leaflets
 - c. Recommended renewal parts list
 - d. Record Documents for the information required by the Submittals above.

1.05 REFERENCE CODES AND STANDARDS

- A. The equipment in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. Underwriters Laboratory (UL)
 - a. UL 1449 Third Edition – Surge Protective Devices
 - b. UL 1283 Electromagnetic Interference Filters
 - c. UL 497B, Protectors for Data Communications and Fire-Alarm circuits.
 2. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
 - a. ANSI/IEEE C62.41.2-2002 – IEEE Recommended Practice on Characterization of Surge Voltages in Low Voltage AC Power Circuits
 - b. ANSI/IEEE C62.45-2002 – IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
 3. National Electrical Code NEC Article 285 - Surge Protective Devices
 4. NEMA/ISCI – 109 Transient Overvoltage Withstand Test
 5. I Institute of Electrical and Electronic Engineers (IEEE)
 - a. IEEE Std. 472/ANSI C37.90A Surge Withstand Capability Tests
 6. IEC 255.4 Surge Withstand Capability Tests
- B. City of Friendswood Electrical Code
- C. All SPDs and their installation shall comply with the requirements of the National Electric Code and Underwriters Laboratories (UL) where applicable.
- D. Each specified device shall also conform to the standards and codes listed in the individual device paragraphs.

1.06 QUALITY ASSURANCE

- A. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- B. The manufacturer of the SPD shall be the same as the manufacturer of the service entrance and distribution equipment in which the devices are installed and shipped. The protected electrical equipment, after installation of the SPD, shall be fully tested and certified to the following UL standards:
1. UL 67 - Panelboards.
 2. UL 845 - Motor Control Centers.
 3. UL 891 - Switchboards.
 4. UL 1558 - Low Voltage Switchgear.
- C. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

1.07 WARRANTY

- A. Provide warranties, including the manufacturer's warranty, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for five years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

1.08 MEASUREMENT AND PAYMENT

- A. Refer to Section 16000.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (480 VAC Power Type 1 and Type 2):
 - 1. Phoenix Contact, VAL-MS 320/3+1.
 - 2. Erico, TDS350TT277
 - 3. Dehn, DG MU 3PY 480 4W+G
- B. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (120 VAC Power Type 3):
 - 1. Erico, TDS1301TR150
 - 2. Phoenix Contact, MAINS-PLUGTRAB PT 2-PE/S-120AC-ST
 - 3. Dehn, DR M 2P 150
- C. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (24 VDC Analog Surge Protection - Control Panel):
 - 1. Erico, UTB30SP
 - 2. Phoenix Contact, MCR-PLUGTRAB PT 1x2-24DC-ST
 - 3. Dehn, BXT ML4 BE 24
- D. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (24 VDC Discrete Surge Protection):
 - 1. Erico, UTB30SP
 - 2. Phoenix Contact, MCR-PLUGTRAB PT 2x1-24DC-ST
 - 3. Dehn, BXT ML4 BD 24
- E. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (120 VAC Discrete Surge Protection):
 - 1. Erico, UTB110DP
 - 2. Phoenix Contact, MCR-PLUGTRAB PT 2x1VA-120AC-ST

3. Dehn, BXT ML4 BE 180
- F. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (24 VDC Power/Analog Surge Protection - Field Devices):
 1. Erico, RTP3034
 2. Phoenix Contact, SURGETRAB, S-PT-EX-24DC
 3. Dehn, BXT ML4 BE 36
- G. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (120 VAC Power/24 VDC Signal Surge Protection - Field Devices):
 1. Erico, MWE and TDS1301TR150
 2. Phoenix Contact, BOXTRAB – BXT-N4X 4-WIRE
 3. Dehn, 999.990-01
- H. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (Data Surge Protection - Ethernet):
 1. Erico, LANRJ45C6
 2. Phoenix Contact, DT-LAN-CAT.6
 3. Dehn, DPA M CLE RJ45B 48
- I. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (Data Surge Protection – RS-485):
 1. Erico, DEPRS42299D
 2. Phoenix Contact, DT-UFB-485/BS
 3. Dehn, BXT ML4 BD HF 5
- J. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (Surge Protection – Device Tester):
 1. Erico, MGA TESTER
 2. Phoenix Contact, CHECKMASTER
 3. Dehn, DRC LC M3+

2.02 SERVICE ENTRANCE AND DISTRIBUTION EQUIPMENT

A. General

1. All SPDs shall be internal to the equipment being protected. Externally housed SPDs will not be acceptable.
2. All SPDs shall be marked with a short-circuit current rating and shall meet or exceed the available fault current at the connection point.
3. UL 1449 Usage Classifications.
 - a. Type 1 – Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment

- overcurrent device and intended to be installed without an external overcurrent protective device.
- b. Type 2 – Permanently connected SPDs intended for installation on the load side of service equipment overcurrent device; including SPDs located at the branch panel.
 - c. Type 3 – Point of utilization SPDs, installed at a minimum conductor length of 10 meters (30 feet) from the electrical service panel to the point of utilization, for example cord connected, direct plug-in, receptacle type and SPDs installed at the utilization equipment being protected. The distance (10 meters) is exclusive of conductors provided with or used to attach SPDs.
4. Construction of Type 1 and Type 2.
- a. Fully Integrated Component Design: All the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together to achieve higher surge current ratings or other functionality will not be accepted.
 - b. Overcurrent Protection: The unit shall contain thermally protected MOVs. The thermally protected MOVs shall have a thermal protection element packaged together with the MOV to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
 - c. 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.
 - d. 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.
 - e. 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 MIL-STD-220A insertion loss test method.
 - f. Internal Connections: No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
 - g. Power and ground connections shall be prewired within the protected equipment.
 - h. 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.

- i. 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 two seconds to clear the surge count total. The ongoing surge count shall be stored in non-volatile memory or UPS backup.
 - j. 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 Drawings. The functions shall be converted as specified for interface to the monitored equipment.
 - k. 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.
 - l. SPD shall be Listed in accordance with UL 1449 Third Edition and UL 1283, Electromagnetic Interference Filters.
 - m. Integrated surge protective devices (SPD) shall be Component Recognized in accordance with UL 1449 Third Edition, 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.
 - n. SPD shall be tested with the ANSI/IEEE Category C High exposure waveform (20kV-1.2/50 μ s, 10kA-8/20 μ s).
 - o. SPD shall provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems (7 Mode).
5. Construction of Type 3.
- a. Fully Integrated Component Design: All the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together to achieve higher surge current ratings or other functionality will not be accepted.
 - 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. 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 MIL-STD-220A insertion loss test method.
- d. Internal Connections: No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
- e. Power and ground connections shall be prewired within the protected equipment.
- f. Local Monitoring: Visible indication of proper SPD connection and operation shall be provided. The indicator light shall indicate that the module is fully operable. The status of each SPD module shall be monitored on the front cover of the module.
- g. SPD shall be Listed in accordance with UL 1449 Third Edition and UL 1283, Electromagnetic Interference Filters.
- h. SPD shall be tested with the ANSI/IEEE Category C High exposure waveform (20kV-1.2/50µs, 10kA-8/20µs).

B. Applications.

- 1. Service Entrance Rated Equipment (Type 1).
 - a. This applies to switchgear, switchboards, panelboards, motor control centers, and other devices installed as service entrance equipment where the SPD is to be permanently connected between the secondary of the service transformer and the line side of the service equipment overcurrent device.
 - b. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
 - c. The SPD shall be of the same manufacturer as the equipment.
 - d. The SPD shall be factory installed inside the equipment, at the assembly point, by the original equipment manufacturer.
 - e. 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.
 - f. The SPD shall be connected through a UL approved disconnecting means. The disconnect shall be in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
 - g. The SPD shall be integral to the equipment as a factory standardized design.
 - h. All monitoring and diagnostic features shall be visible from the front of the equipment.

2. Distribution Equipment Applications (Type 2).
 - a. This applies to switchgear, switchboards, panelboards, motor control centers, and other non-service entrance equipment where the SPD is to be permanently connected on the load side of the equipment overcurrent device.
 - b. The SPD shall be of the same manufacturer as the equipment.
 - c. The SPD shall be included and mounted within the equipment by the manufacturer.
 - d. The manufacturer shall size and provide the overcurrent and disconnecting means for the SPD.
 - e. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.
 - f. The SPD shall be located within the panelboard, unless otherwise shown on the Drawings. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
 - g. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
 - h. All monitoring and diagnostic features shall be visible from the front of the equipment.
3. Individual Control Panel and Related 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 disconnect circuit breaker or fuse as shown on the drawings. The disconnecting means shall be in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
 - c. All monitoring and diagnostic features shall be visible from the front of the equipment.
4. Mechanical Equipment Manufacturer's Provided Control Panels (MEMs) and Electrical Manufacturer's Provided Control Panels (OEMs) Applications (Type 1, Type 2, and Type 3)
 - a. Where any such panel is installed as service entrance equipment, a Type 1 SPD shall be installed.
 - i. The same requirements for other service entrance equipment listed above apply to this application except for the requirement that the Type 1 SPD shall not be required to be of the same manufacturer as the panel.
 - b. Where any such panel is installed as non-service entrance equipment, but within 50' of wire length of the incoming power line when that line is overhead.

- i. The same requirements for other non-service entrance equipment listed above apply to this application except for the requirement that the Type 2 SPD shall not be required to be of the same manufacturer as the panel.
- ii. Where a Type 1 SPD is installed, a Type 2 SPD is not required on the same panel unless otherwise specifically shown on the drawings.
- c. Where any such panel includes a PLC, a Type 3 SPD shall be installed.
 - i. The same requirements for other individual control panel and related equipment listed above apply to this application.
 - ii. The SPD shall be integral to the MEM or OEM panel, as a factory standardized design.

C. Ratings

- 1. Unit Operating Voltage: Refer to drawings for operating voltage and unit configuration.
- 2. SPD shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.
- 3. Minimum surge current rating shall be 240 kA per phase (120 kA per mode) for service entrance and 120 kA per phase (60 kA per mode) for distribution applications.
- 4. 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>
240/120	1200/800V	800V	800V
208Y/120	800V	800V	800V
480Y/277	1200V	1200V	1200V
600Y/347	1500V	1500V	1500V
- 5. 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%.
- 6. Minimum UL 1449 3rd edition withstand Nominal Discharge Current (In) rating to be 20kA per mode.

2.03 SPARE PARTS

- A. Provide the following control system network component spare parts:
 - 1. One per five of each type of surge protective device; minimum of one of each type of surge protective device.

2.04 ACCESSORIES

- A. Furnish nameplates for each device as indicated on drawings. Color schemes shall be as indicated on Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. All equipment specified herein shall be factory installed, field adjusted, tested, and cleaned as an integral part of equipment specified elsewhere in the individual equipment Specification.
- B. Types 1 and 2 shall be grounded and bonded as a part of the individual equipment as specified in the individual equipment Section. Type 3 shall be grounded and bonded in accordance with the SPD manufacturer's instructions.
- C. Conductor length between suppressor and connection point shall be as short and as straight as possible.
- D. Upon completion of installation, provide the services of a factory-certified local service technician to perform start-up testing. Record test results and compare to factory testing to confirm proper operation of equipment. Submit test results with operation and maintenance manuals.

END OF SECTION

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SECTION 16197

POWER METERING AND PROTECTIVE RELAYS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section of the Specifications describes the requirements for power metering and protective relays to be furnished under other Sections of the Specifications to which reference is made in the Related Work paragraph of this Section.
- B. All equipment described herein shall be submitted and furnished as an integral part of equipment specified elsewhere in these Specifications.

1.02 RELATED WORK

- A. Refer to Section 16000 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

- A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 16000, the following:
 - 1. Manufacturers' names and product designation or catalog numbers of all materials specified.
 - 2. Cut sheets for each individual item shall be submitted.
 - 3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.
- B. Submittals for equipment and materials, furnished under this Section of the Specifications, will not be accepted prior to approval of the Power System Study specified under Section 16105. Submittals made prior to such approval will be returned unreviewed.
- C. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will also be returned without review.
- D. Submit catalog data for all items supplied from this specification Section as applicable. Submittal shall include catalog data, functions, ratings, inputs, outputs, displays, etc., enough to confirm that the meter or relay provides every specified requirement. Any options or exceptions shall be clearly indicated.
- E. Operation and Maintenance Manuals.
 - 1. Operation and Maintenance manuals shall include the following information:
 - a. Manufacturer's contact address and telephone number for parts and service.
 - b. Instruction books and/or leaflets

- c. Recommended renewal parts list
- d. Record Documents for the information required by the Submittals above.

1.04 REFERENCE CODES AND STANDARDS

- A. The equipment in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):
 - 1. NEMA/ISCI – 109 Transient Overvoltage Withstand Test
 - 2. IEEE Std. 472/ANSI C37.90A Surge Withstand Capability Tests
 - 3. IEC 255.4 Surge Withstand Capability Tests
- B. All meters, relays and associated equipment shall comply with the requirements of the National Electric Code and Underwriters Laboratories (UL) where applicable.
- C. Each specified device shall also conform to the standards and codes listed in the individual device paragraphs.

1.05 QUALITY ASSURANCE

- A. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- B. Equipment submitted shall fit within the space or location shown on the Drawings. Equipment which does not fit within the space or location is not acceptable.
- C. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

1.06 WARRANTY

- A. Provide warranties, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner

1.07 MEASUREMENT AND PAYMENT

- A. Refer to Section 16000.

PART 2 PRODUCTS

2.01 GENERAL

- A. Metering and Protective Relay Enclosures
 - 1. Enclosures for meters and protective relays located within the associated equipment shall have the same Enclosure Types as specified for the associated equipment.

B. Settings

1. Refer to Section 16105 Power System Study for relay settings.
2. Control and Instrument Power Transformers
 - a. Control power transformers shall be furnished as shown on the Drawings. Transformer mechanical ratings shall equal the BIL and momentary rating of the circuit breakers. Transformers, when mounted in switchgear assemblies, shall be rated for the full voltage of the switchgear. Transformer shall be sized for the entire load, including space heaters, plus 25% spare capacity, and shall be not less than 100 VA. Provide a load calculation showing that the sizing of the control power transformer complies with this requirement.
 - b. All control power transformers shall have vacuum cast primary and secondary coils using epoxy resin. Voltage and control power transformers of the quantity and ratings indicated. Control power transformers shall be 120 volts grounded secondary. Primary side of the transformer shall be fused in both legs. One leg of the transformer secondary shall be solidly grounded while the other leg shall be fused.
3. Current Transformers
 - a. Current transformers shall be furnished as indicated on the contract drawings. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their accuracy rating shall be equal to or higher than ANSI standard requirements. The location for the current transformers shall be front accessible to permit adding or changing current transformers without removing high-voltage insulation connections.
 - b. Current transformers for power quality meters shall be instrument accuracy. Meters and relays shall not be placed on the same current transformer circuit. Provide separate current transformers for relays and for meters.
 - c. Provide separate current transformers for differential relays shown on the drawings.
 - d. Shorting terminal blocks shall be furnished on the secondary of all the current transformers.

2.02 POWER QUALITY METER (PM1)

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 1. GE Multilin PQMII Power Quality Meter
 2. Siemens PAC4200 Power Meter
 3. Or Approved Equal
- B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

C. General

1. All circuit boards shall have a harsh environment conformal coating to resist H₂S gas and other corrosive agents, including humidity.

D. Monitoring and Metering

1. Metering Functions with accuracy of 0.2% for A & V and 0.4% for power parameters
 - a. A, V, VA, W, VAR, KWH, KVARH, KVAH, PF, Hz
 - b. W, VAR, A, VA Demand
 - c. A, V Unbalance
2. Power Analysis Functions.
 - a. Total Harmonic Distortion
 - b. Individual harmonics
 - c. Waveform capture
 - d. Historical data
 - e. Minimum and maximum metered values complete with time and date
 - f. Record of last 40 events
 - g. Two independent data logs

E. User Interface and Programming

1. Integrated keypad to access actual values and set points.
 - a. 2 - line, 40 character illuminated display for use with keypad. The display shall have:
 - i. Variable scrolling rates.
 - ii. Front mounted LEDs to display alarms, communication status, relay status, simulation mode, self-test failure, and set point access status.
 - iii. Relay reset button to clear alarm and auxiliary conditions.
2. The meter shall have one alarm output relay with Form C contacts.
3. Relay output shall be through alarm, auxiliary and pulse output functions.
4. The meter shall provide a user configurable pulse output based on KWH, KVARH or KVAH.
5. The meter shall provide a pulse input for demand synchronization.
6. The meter shall include a simulation mode capability for testing the functionality and meter response to programmed conditions without the need for external inputs.
7. The relay shall include a power systems option consisting of harmonic analysis, triggered trace memory waveform capture, event record and data logger functions.

F. Control Power:

1. Range of available control power: DC: 88-300 VDC; AC: 70-265 VAC, 48 to 62 Hz.
2. LO Range: DC: 20-60 VDC; AC: 20-48 VAC, 48 to 62 Hz.

G. Communication

1. For remote monitoring, the following communication ports shall be provided:
 - a. One Industry Standard port for meter and relay programming using a laptop computer.
 - b. One RS-485 port.
 - c. One integral 10/100BaseT Ethernet port . The connection shall support Modbus TCP, Ethernet IP and SNMP. Where an integral port is not available, provide a media protocol converter as specified herein.
 - d. The manufacturer shall factory enter the proper IP Address for such connection. Upon request by the Contractor, the Owner/Engineer will provide the proper Internet Protocol Address (IP Address), to be configured by the equipment manufacturer.
2. The protocol interface shall implement Ethernet/IP Protocol with the following as minimum capabilities:
 - a. Transfer of basic I/O data via User Datagram Protocol (UDP)-based implicit messaging.
 - b. Uploading and downloading of parameters, set points, programs and recipes via TCP (i.e., explicit messaging.)
 - c. Polled, cyclic and change-of-state monitoring via UDP.
 - d. One-to-one (unicast), one-to-many (multicast), and one-to-all (broadcast) communication via TCP
 - e. Use of well-known TCP port number 44818 for explicit messaging and UDP port number 2222 for implicit messaging.
 - f. All data shall be available and/or mirrored within the Modbus 4x or "Holding Register" memory area.
 - g. Register 4x00001 shall exist and be readable to allow simple, predictable "comm tests".
 - h. Software tools shall function properly with slaves' only supporting Modbus functions 3, 4 and 16. Requiring support of diagnostic function 8 is not acceptable.
 - i. Software tools shall be configurable to write a single register as either function 6 or 16.
 - j. Software tools shall allow setting the Modbus/TCP "Unit Id" to be a value other than zero. This is required for Ethernet-to-Serial bridging.

3. The media protocol converter shall meet the following criteria:
 - a. The converter shall support 10/100Base-T Ethernet. The serial port speed (baud rate) shall support 230kbps. The protocol shall support Modbus TCP, Ethernet IP, DF1, and Modbus RTU/ASCII. Protocol shall be Web Browser configurable.
 - b. Operating limits shall be 0-60°C, with humidity range minimum of 5-90%. Shock capability on the serial port shall be ESD +15 kV air GAP meeting IEC 1000-4-2. Power requirements shall be 9-30VDC at 0.5A minimum.
 - c. The converter shall have LED status for serial, signals, power, and Ethernet.
 - d. The converter housing shall be UL 1604, Class 1 Div. 2, DIN Rail mountable. The converter shall have DB-9M port connection, with screw terminals, to the input.
 - e. Converter shall be Digi One IAP or approved equal.

2.03 PHASE FAILURE RELAY (PFR)

- A. Manufacturer, Product: Diversified Electronics Inc.; Model SLA Series or approved equal.
- B. Description: All three phases monitored individually for preselected under and over voltage limit phase loss, phase unbalance, phase reversal, frequency shift and phase shift. Automatic reset after adjustable release delay when line conditions return to normal.
- C. Indicators: LED indicators all three phases.
- D. Output Rating: DPDT, 3 amps resistive at 600 VAC.
- E. Phase Sequence: ABC.
- F. Sampling Time: 2 seconds.
- G. Agency Approvals: UL listed.
- H. Spare Unit: In addition to the unit installed, furnish one spare phase/voltage monitor relay.

2.04 LOAD CURRENT MONITORING TRANSDUCER

- A. Where a load monitoring current transducer is shown on the drawings or specified, provide a solid core or split core CT with an integral current transducer which accepts a 0-to-5-amp input from the CT and provides a 4-20 milliamp DC current output.
- B. Transducers monitoring non-sinusoidal loads associated with variable frequency drives (VFD) or silicon-controlled rectifier (SCR) applications shall have a built-in mathematical algorithm that integrates the wave form over time to produce a true RMS output.
- C. The CT primary shall be selected based on the full load rating of the load that is being monitored. The transducers shall be UL listed.

D. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Automation Direct.
2. Approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. All equipment specified herein shall be factory installed, field adjusted, tested, and cleaned as an integral part of equipment specified elsewhere in these Specifications. All current transformers shall have their leads terminated on shorting type terminal blocks before continuing to any other devices.

B. Enclosure Mounting Requirements:

1. Meters and relays integral to MCC
 - a. Meters and relays shall be mounted integral to the MCC as shown or specified, unless specified or shown to be mounted in separate enclosures.
2. Separately mounted meters and relays
 - a. Separately mounted relays and meters shall be mounted in enclosures meeting the requirements of Section 16110 Raceways, Boxes, Enclosures and Fittings.
 - b. Mount all separately-mounted enclosures with an air gap between the enclosure and wall or mounting plate. Create the air space with slotted channel or several stainless-steel washers which together will make at least a 1/4-inch space.
 - c. Provide integral welded on mounting feet for floor mounted enclosures.
 - d. Provide all enclosures with integral welded-on mounting lugs and use only the integral mounting lugs to mount the enclosure. Drilling through the back of any enclosure to provide a mounting means is prohibited. Any enclosure drilled to provide a mounting means will be rejected and shall be replaced with no change in Contract Time or Price even if the enclosure installation is complete with raceway attached and conductors installed.
 - e. Penetrations in any enclosures with a NEMA 3R, 4 or 4X rating which is located in any wet or damp area or in any process area whether it appears to be dry or not shall be in the sides or bottom only. Top penetrations in any enclosure located as described herein shall not be done for any reason, including raceway entries or equipment mounting. Top penetrations by the Contractor or by the original equipment manufacturer in the factory are all prohibited. Any enclosure with a top penetration located in the areas specified will be rejected and shall be removed and replaced, even if it requires a return to the factory. Raceway penetrating the top shall be re-routed and re-installed. All installed conductors in re-routed raceway shall be removed and re-routed in the re-routed raceway. Conductors found to be too short to be re-terminated shall be removed back to their source or load as the case may be and shall be

replaced. Splicing is prohibited and unacceptable. All specified corrective measures shall be provided with no change in Contract Time or Price.

END OF SECTION

SECTION 16220

AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.01 SCOPE

- A. Furnish and install the low voltage automatic transfer switches having the ratings, features/accessories and enclosures as specified herein and as shown on the contract drawings.

1.02 REFERENCES

- A. The automatic transfer switches shall be UL listed for use in standby systems in accordance with Sections 517, 700, 701 and 702 of the National Electrical Code and shall be designed, built and tested in accordance with the latest editions and revisions of the following standards and codes:
 - 1. UL 1008 - Transfer Switches
 - 2. CSA C22.2 No. 178: Automatic Transfer Switches
 - 3. UL 991: Standard for Tests for Safety-Related Controls Employing Solid-State Devices
 - 4. NFPA 70 - National Electrical Code
 - 5. NFPA 99: Essential Electrical Systems of Health Care Facilities
 - 6. NFPA 110 - Emergency and Standby Power Systems
 - 7. NEMA ICS 10 - AC Transfer Switch Equipment
 - 8. IEEE 446 - Recommended Practice for Emergency and Standby Power Systems
 - 9. UL 508 Industrial Control Equipment

1.03 SUBMITTALS

- A. Submit the following:
 - 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. Schematic diagrams.

4. Wiring diagrams.
5. Assembly ratings including:
 - a. Voltage rating
 - b. Continuous current rating
 - c. Withstand and closing ratings
6. Cable terminal sizes
7. Product data sheets.
8. Accessory list.

1.04 OPERATION AND MAINTENANCE MANUALS

- A. Operation and Maintenance Manuals: Provide three (3) hard copies in 3-ring binders and one (1) electronic copy on USB flash drive of Operation and Maintenance manuals.

1.05 QUALITY ASSURANCE

- A. A factory authorized service and parts organization shall have a factory certified field service representative located within 100 miles that is available to arrive at the project site within 4 hours after being called. Provide the name and address of the factory authorized service and parts organization nearest to the project location at the time of the bid.
- B. Equipment components and devices shall be UL listed to the extent possible wherever UL standards exist for such equipment.
- C. The automatic transfer switch manufacturer shall demonstrate at least ten years of continuous field operating experience in automatic transfer switch design and fabrication within the last fifteen years. Submit customer/user list with telephone numbers, addresses and names of customer/user representatives.
- D. The manufacturer of the assembly shall be the manufacturer of major components and control modules installed within the assembly.
- E. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Package the automatic transfer switch for maximum protection during delivery and storage. The ATS shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

- B. Equipment being stored prior to installation shall be maintained in a clean and dry condition. If stored outdoors, indoor equipment shall be covered and heated, and outdoor equipment shall be heated.

1.07 WARRANTY

- A. Base Warranty: Manufacturer shall provide manufacturer's base warranty coverage on the material and workmanship of the automatic transfer switch, including all components and appurtenances or a minimum of 2 years from registered commissioning and start-up.
- B. Extended Warranty: Manufacturer shall offer extended coverage of 5 years from date of registered commissioning and start-up.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Russelectric
- B. ASCO
- C. Eaton
- D. ABB
- E. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.02 CONSTRUCTION

- A. Transfer switches shall be UL 1008 listed for application in their intended enclosures at 100% of continuous ampere rating and shall meet or exceed UL 1008 endurance test criteria to include rate of operation and number of operation cycles.
- B. Switching devices for transfer switches shall be contactor-type mechanism. All contactors shall be UL listed for application in their intended enclosures for 100% of their continuous ampere rating.
- C. Each transfer switch shall be positively interlocked both mechanically and electrically to prevent the simultaneous closing of both sources under either automatic or manual operation. Main contacts shall be mechanically held in position in both normal and emergency positions.
- D. Transfer switches shall be open delayed transition type and operate with a time delay in the neutral position, adjustable from 0 to 120 seconds.

- E. The automatic transfer switch shall be of double throw construction operated by a reliable electrical mechanism momentarily energized. There shall be a direct mechanical coupling to facilitate transfer in 6 cycles or less.
- F. Contactors or components thereof not specifically designed, as an automatic transfer switch will not be acceptable.
- G. The switching panel shall consist of a separate control or transformer panel. Control power for all transfer operations shall be derived from the line side of the source to which the load is being transferred. The transformer shall be multi-tap for ease of voltage adjustment in the field.
- H. Transfer switches will be supplied with a manual-operating handle. Manual operation shall only be performed with the switch de-energized.
- I. On transfer switches requiring a fourth pole for switching the neutral, the neutral shall be identical to the other power poles. Switched neutral poles which are add-on or overlap, or that are not capable of breaking full rated load current are not acceptable.
- J. On transfer switches requiring a solid neutral, the neutral shall be fully rated.

2.03 ENCLOSURE

- A. Each transfer switch shall be provided in a NEMA 4X 316 stainless steel enclosure suitable for use in environments indicated in the Contract Drawings.

2.04 MICROPROCESSOR CONTROLLER LOGIC

- A. The transfer switch microprocessor controller logic shall be an Eaton ATC-300+ automatic controller. Operation of the transfer switch and monitoring of both sources shall be managed by the controller. The controller shall be hardened against transient voltages.
- B. The controller shall have an operating temperature range from -20 to +70 degrees C (-4 to +158 degrees F) and a storage temperature range from -30 to +85 degrees C (-22 to +185 degrees F). The controller faceplate shall be UV resistant.
- C. The controller shall be capable of accepting 120Vac supply power from two (2) different sources.

2.05 CONTROLLER DISPLAY AND KEYPAD

- A. The microprocessor-based controller display shall be UV resistant and include a 2-line, 16-character, backlit LCD display. The controller shall be capable of displaying transfer switch status, parameters, and diagnostic data. All set point parameters shall be password protected and programmable using the controller keypad or remotely using serial port access.

- B. The microprocessor-based controller shall include one (1) unit status LED (3mm) and a mimic power bus consisting of four (4) LED's (3mm) for indicating the following:
1. Availability status of Source 1
 2. Availability status of Source 2
 3. Connection status of Load to Source 1
 4. Connection status of Load to Source 2
- C. The controller keypad shall include the following pushbutton controls:
1. ENGINE TEST, for use with a generator source.
 2. PREVIOUS, and NEXT for ease of navigation
 3. INCREMENT, DECREMENT, and ENTER for programming.
 4. HELP/LAMP TEST, for operator assistance and diagnostics
 5. BYPASS TIMER, to bypass time delay countdown
- D. The controller shall display voltage and frequency for source 1, source 2, and the load.

2.06 VOLTAGE AND FREQUENCY SENSING

- A. The controller shall have a voltage range of 0-790 volts (50/60 Hz) and an accuracy of +/- 1% of nominal input voltage and a frequency range of 40-70 Hz, and an accuracy of +/- .3 Hz.
- B. The normal and emergency sources shall include phase reversal protection. The preferred rotation is programmable as ABC or CBA.
- C. Voltage and frequency dropout and pickup setpoints, for source 1 and source 2, shall be adjustable as a percentage of nominal per the table below. Pickup and dropout setpoints for overvoltage, underfrequency, overfrequency, and voltage unbalance / phase loss shall be capable of being disabled.

Setpoint	Sources	Dropout	Pickup
Undervoltage	Source1 and 2	70 – 97%	(DO + 2%) - 99%
Overvoltage	Source 1 and 2	105 – 110%	103% - (DO – 2%)
Under frequency	Source 1 and 2	90 – 97%	(DO + 1Hz) – 99%
Over frequency	Source 1 and 2	103 – 105%	101% - (DO – 1Hz)
Voltage Unbalance	Source 1 and 2	5 – 20%	(UNBAL DO% - 2) – 3%

2.07 CONTROLLER TIME DELAYS

- A. A time delay shall be provided for transfer from source 1 to source 2, adjustable from 0 to 1800 seconds. Set delay at 30 seconds.
- B. A time delay shall be provided on retransfer from source 2 to source 1, adjustable from 0 to 1800 seconds. Set delay at 300 seconds.
- C. A time delay shall be provided for actuation of an engine start signal, adjustable from 0 to 120 seconds, for overriding momentary power fluctuations. Set time delay at 10 seconds.
- D. A time delay shall be provided allowing the load connection to remain in the “neutral position” (disconnected from source 1 and source 2), adjustable from 0 to 120 seconds.
- E. A time delay shall be provided that allows the generator to run unloaded, adjustable from 0 to 0-1800 seconds, for cool-off prior to shut down.
- F. A time delay shall be provided to postpone the generator source from being declared unavailable, fixed at 6 seconds, for overriding momentary power fluctuations.
- G. A time delay shall be provided for actuation of a pre-transfer signal, adjustable from 0 to 120 seconds. The contact shall be a form-c contact rated for 10-Amp at 250-Vac and 10-Amp at 30-Vdc.
- H. A time delay shall be provided to allow synchronization of sources, adjustable from 0 to 60 minutes (0 to 600 seconds), for use with in-phase transition transfer.
- I. A time delay shall be provided for voltage unbalance, adjustable from 10 to 30 seconds.
- J. All time delays shall be programmable, using the controller keypad, without the use of special tools.

2.08 ADDITIONAL FEATURES

- A. One Form A contact for closure of the Generator start circuit. The contacts shall be of silver alloy with gold flashing. The contacts shall be rated for 5-Amp at 250-Vac and 5-Amp at 30-Vdc.
- B. Programmable Engine Exerciser, selectable as disabled, 7, 14, or 28-day interval, adjustable 0-600 minutes, load or no load with Failsafe.
- C. The controller shall include a keypad pushbutton to initiate a system test.
- D. The controller shall include a keypad pushbutton to bypass the time delay on transfer to emergency and the time delay on retransfer to normal.

- E. The controller shall include a terminal input to accept a remote contact which closes to initiate a transfer to source 2. This feature shall be failsafe and an automatic retransfer shall occur in the event that source 2 power is lost.
- F. The controller shall include a terminal input to accept a remote contact which opens to inhibit transfer to source 2.
- G. One Form C auxiliary contact to indicate Source 1 position and one Form C contact to indicate source 2 position. The contacts shall be rated for 10-Amp, 1/3-Horsepower at 250-Vac and 10-Amp at 30-Vdc.
- H. One Form C contact for NORMAL Source Available. The contacts shall be rated for 10-Amp, 1/3-Horsepower at 250-Vac and 10-Amp at 30-Vdc.
- I. One Form C contact for EMERGENCY Source Available. The contacts shall be rated for 10-Amp, 1/3-Horsepower at 250-Vac and 10-Amp at 30-Vdc.
- J. Space heater: Provide a 100W rated space heater with thermostat.
- K. Historical Data Storage to include:
 - 1. Engine Run Time
 - 2. NORMAL source Available time
 - 3. EMERGENCY source Available time
 - 4. NORMAL source Connected time
 - 5. EMERGENCY source Connected time
 - 6. LOAD Energized Time
 - 7. Number of Transfers
 - 8. Date, Time and Reason for Last Sixteen (16) transfers
 - 9. Monitor Mode Event
 - 10. Fail Safe Event
 - 11. Aborted Test

2.09 ADDITIONAL REQUIREMENTS

- A. The transfer switch shall have a withstand and closing rating of 50kA at 480 volts.

PART 3 EXECUTION

3.01 EXAMINATION

3.02 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.
 - 1. Insulation check to ensure the integrity of insulation and continuity of the entire system
 - 2. Visual inspection to ensure that the switch matches the specification requirements and to verify that the fit and finish meet quality standards
 - 3. Mechanical tests to verify that the switch's power sections are free of mechanical hindrances
 - 4. Electrical tests to verify the complete electrical operation of the switch and to set up time delays and voltage sensing settings of the logic
- B. The manufacturer shall provide a certified copy of factory test reports.
- C. Transfer switch shall include a label indicating order number, catalog number and date

3.03 INSTALLATION

- A. The Contractor shall install the equipment in accordance with the manufacturer's recommendations and in accordance with the contract drawings.
- B. All necessary hardware to secure the assembly in place shall be provided by the contractor.

3.04 FIELD QUALITY CONTROL

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of 2 working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

3.05 MANUFACTURER'S CERTIFICATION

- A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

- B. The Contractor shall provide a copy of the manufacturer's representative's certification.

3.06 TRAINING

- A. The manufacturer's qualified representative shall conduct a training session for up to five (5) owner's representatives for upto 4 hours at a location determined by the owner. The training program shall consist of the instruction on the operation of the transfer switch and the major components within the assembly.

3.07 FIELD SERVICE ORGANIZATION

- A. The manufacturer of the ATS shall also have a national service organization that is available throughout the contiguous United States and is available on call 24 hours a day, 365 days a year.

END OF SECTION

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SECTION 16461

DISTRIBUTION DRY-TYPE TRANSFORMERS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install single-phase and three-phase general purpose individually mounted dry-type transformers of the two-windings type, self-cooled as specified herein, and as shown on the Drawings.
- B. The provisions of this Section shall apply to all dry-type distribution transformers, except as indicated otherwise.

1.02 RELATED WORK

- A. Refer to Section 16000 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

- A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 16000, the following:
 - 1. Manufacturers' names and product designation or catalog numbers of all materials specified.
 - 2. Cut sheets for each individual item shall be submitted.
 - 3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.
- B. Submittals for equipment and materials, furnished under this Section of the Specifications, will not be accepted prior to approval of the Power System Study specified under Section 16105. Submittals made prior to such approval will be returned without review.
- C. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will also be returned without review.
- D. All equipment supplied under this Section of the Specifications shall be products of the same Manufacturer and shall be contained in one single submittal. Partial submittals will be returned without review. Submittals shall also contain information on related equipment to be furnished under this Specification but described in the related sections listed in the Related Work paragraph above. Incomplete submittals not containing the required information on the related equipment will also be returned without review.
- E. Equipment specified in Process Equipment and Mechanical Equipment Divisions and supplied as an integral part of a process equipment manufacturer's package, but

referred to this Section for component details, shall be submitted with the manufacturer's package in those Divisions.

- F. Shop Drawings and Product Data. For each transformer specified under this Section, submit the following information:
1. Outline dimensions and weights
 2. Typical/Design test data
 3. Transformer ratings including:
 - a. kVA
 - b. Primary and secondary voltage
 - c. Taps
 - d. Basic impulse level (BIL) for equipment over 600 volts
 - e. Design impedance
 - f. Insulation class and temperature rise
 - g. Test reports are required for equivalent of supplied transformers 300 KVA and above, indicating losses at 25, 50, 75 and 100 percent rated load and sound levels.
 - h. Catalog data.
 - i. Sound level.
 4. Product data sheets
 5. Connection diagrams
 6. Installation information
 7. Date of manufacture for each transformer
 8. Where applicable the following additional information shall be submitted to the Engineer:
 - a. Specified accessories
- G. Operation and Maintenance Manuals.
1. Operation and Maintenance Manuals shall include the following information:
 - a. Manufacturer's contact address and telephone number for parts and service.
 - b. Instruction books and/or leaflets
 - c. Recommended renewal parts list
 - d. Record Drawings of information required by the Submittals part of this Section.
 - e. Project record drawings clearly indicating operating features and including as-built shop drawings, outline drawings, and schematic and wiring diagrams.

1.04 REFERENCE STANDARDS

- A. The dry-type transformer(s) and all components shall be designed, manufactured and tested in accordance with the latest applicable NEMA and ANSI standards as follows:
 - 1. DOE 2016 Energy Efficiency Standards, 10 CFR Part 431
 - 2. ANSI No. C89.2: Dry Type Transformers for General Applications
 - 3. ANSI C57.96 2004 Guide for Loading Dry-Type Distribution and Power Transformers
 - 4. ASTM D635 – Standard Test Method for Insulation Materials
 - 5. NEMA ST20 Dry-Type Transformers for General Applications
 - 6. UL 1561 Standard for Dry Type-Type General Purpose and Power Transformers
 - 7. IEEE-519 Standards for Harmonic Control in Electric Power Systems
 - 8. NFPA 70 – National Electrical Code

1.05 QUALITY ASSURANCE

- A. The manufacturer of this equipment shall have produced similar equipment for a minimum period of ten years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- B. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly. All assemblies shall be of the same manufacturer. Equipment that is manufactured by a third party and “brand labeled” shall not be acceptable.
- C. All components and material shall be new and of the latest field proven design and in current production. Obsolete components or components scheduled for immediate discontinuation shall not be used.
- D. Equipment submitted shall fit within the space shown on the Drawings. Equipment which does not fit within the space is not acceptable.
- E. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.
- F. Transformers manufactured more than 24 months prior to the date of this Contract will not be acceptable.
- G. Transformers shall meet the US Department of Energy (DOE) 2016 Energy Efficiency Standards 10 CFR Part 421.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

- A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, or equipment which failed any factory tests, will not be permitted.

- B. Equipment shall be handled and stored in accordance with manufacturer's instructions. Two copies of these instructions shall be included with the equipment at time of shipment, and shall be made available to the Contractor and Owner/Engineer
- C. Shipping groups shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. All accessories shall be packaged and shipped separately.
- D. Equipment shall be equipped to be handled by crane. Where cranes are not available, equipment shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.
- E. Equipment shall be installed in its permanent finished location shown on the Drawings within seven calendar days of arriving onsite. If the equipment cannot be installed within seven calendar days, the equipment shall not be delivered to the site, but stored offsite, until such time that the site is ready for permanent installation of the equipment with no change in Contract Price or Schedule.
- F. Where space heaters are provided in equipment, provide temporary electrical power, and operate space heaters during jobsite storage, and after equipment is installed in permanent location, until equipment is placed in service.

1.07 WARRANTY

- A. Provide warranties, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner

1.08 MEASUREMENT AND PAYMENT

- A. Refer to Section 16000.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 - 1. ABB
 - 2. Eaton
 - 3. Schneider Electric
 - 4. Or Approved equal.
- B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions.

Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.02 RATINGS

A. The ratings of the transformer shall be as follows:

1. kVA Rating: As shown on the Drawings.
2. Impedance: ANSI Standard Tolerance
3. HV: As shown on the Drawings.
4. LV: As shown on the Drawings.
5. LV: As shown on the Drawings if applicable.

2.03 CONSTRUCTION

A. Insulation Systems

1. Transformer insulation system shall be as follows:
 - a. Up to 15 kVA, three-phase and single-phase: UL recognized 180°C rated insulation system, encapsulated with 115°C rise.
 - b. 15 kVA, and above, three-phase and single-phase: UL recognized 200°C rated insulation system, ventilated, with 115°C rise.
2. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40°C maximum ambient, and a 24-hour average ambient of 30°C
3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.
4. Windings shall have a BIL of 10 kV minimum.

B. Core and Coil Assemblies

1. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade copper with continuous wound construction.
2. Transformer coil assembly shall be impregnated with non-hygroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture; the core shall be coated with HAPs (Hazardous Air Pollutants) free water reducible electrical varnish to give good corrosion resistance. The assembly shall be installed on vibration-absorbing pads.
3. On single and three-phase units rated 15 kVA and below, the core and coil assembly shall be encapsulation system and shall minimize the sound level.

Enclosure construction shall be encapsulated, non-ventilated 316 stainless steel enclosure, with lifting eyes.

4. On single and three-phase units, rated above 15 kVA, the core and coil assembly shall be ventilated, weatherproof 316 stainless steel enclosure. All ventilation openings shall be protected against falling dirt. The assembly shall be installed on vibration-absorbing pads.
5. Terminals shall be welded to the leads of the coils for better conductivity, less maintenance and lower risk of hot spots. Terminals shall not be spot welded or bolted to the coil leads.
6. The neutral bus shall be configured to accommodate 200% of the rated current.

C. Taps

1. Three-phase transformers rated 15 through 500 kVA shall be provided with six 2-1/2% taps, two above and three below rated primary voltage.
2. All single-phase transformers, and three-phase transformers rated below 15 kVA and above 500 kVA, shall be provided with the manufacturer's standard tap configuration.

D. Isolation Pad

1. Each transformer, pad-mounted, bracket-mounted, or suspended, shall utilize double deflecting neoprene mounting vibration isolators as manufactured by Mason Industries Type ND, sized according to rated capacities.

E. Finish

1. Enclosures, other than stainless steel, shall be finished with ANSI Gray color, weather-resistant enamel.

F. Accessories

1. On ventilated outdoor units provide suitable weather shields over ventilation openings.
2. Lug kits shall be provided by the Manufacturer of the transformer.

G. Electrostatic Shielding

1. Where shown on the drawings, provide shielded isolation transformers with an electrostatic shield consisting of an independent single full width electrostatic shield consisting of a single turn of copper placed between the primary and secondary winding and grounded to the housing of the transformer.
 - a. Electrostatic shield shall provide primary-to-secondary winding capacitance between 24 and 18 picofarads over the range of 100 Hz to 20 kHz.
 - b. Electrostatic shielding shall provide the following minimum attenuation when tested per MIL Std. 220A, Method of Insertion Loss Measurement, with matched impedance no load technique.
 - i. Common mode noise attenuation: Minus 80 dBA minimum at 0.1 kHz to 1.5 kHz,

- ii. Common mode noise attenuation: Minus 55 dBA minimum at 1.51 kHz to 100 kHz.
- iii. Normal mode (Transverse mode) noise attenuation: Minus 35 dBA minimum at 1.5 kHz to 10 kHz

H. Motor Drive Isolation

1. Where shown on the drawings, provide motor drive isolation transformers.
2. Motor drive isolation transformers shall be designed for use with three-phase AC adjustable frequency drives 600 volts and below to provide isolation between the incoming line and drive circuitry. The drive isolation transformers shall minimize the line disturbances caused by SCR firing within the drive unit. Thermoguards shall be included in all motor drive isolation transformers to provide additional protection for the transformer from increased heating due to the non-sinusoidal characteristics of the drive currents. The transformer shall provide reduced short-circuit currents and voltage line transients. The transformer shall be specifically sized to the drive kVA requirements dictated by the horsepower of the motor and specified drive size as specified and/or shown on the drawings. The transformers shall be mechanically braced to withstand the stress of current reversals and short-circuit currents associated with the specific drive kVA rating.
3. Motor drive isolation transformer shall have harmonic mitigation features as follows:
 - a. Transformers shall provide all the features specified herein. In addition, they shall be two-winding construction. The primary winding shall be delta connected and the secondary winding shall be wye-zigzag with a wye field connection.
 - b. Provide low positive / negative sequence impedance between 4.6% and 7.2%, low zero-sequence impedance / reactance less than 0.55% and 0.47% respectively.
 - c. Triplen harmonics shall be treated in the secondary windings through flux cancellation and not coupled into the primary delta winding.
 - d. The transformer shall treat the 5th and 7th harmonic currents through the pairing of transformers such that these harmonic currents subtract at the common bus feeding the transformers with harmonics produced by other similar sources in the secondary windings in the secondary windings.
 - e. Fundamental current imbalance shall be reduced on the primary when compared to the secondary load measurements.
 - f. Harmonic treatment shall be accomplished through electromagnetic means. Filters, capacitors, power electronic circuitry or other such devices shall not be used to mitigate harmonics.
 - g. Provide thermal sensors set at 190°C to trip and a second set of sensors set at 175°C to alarm. Thermal sensors shall be factory-installed in the center of the

transformer coil and factory-wired to terminal blocks. Thermal sensors output shall be dry contacts.

2.04 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest applicable ANSI and NEMA standards.
 - 1. Ratio tests at the rated voltage connection and at all tap connections
 - 2. Polarity and phase relation tests on the rated voltage connection
 - 3. Applied potential tests
 - 4. Induced potential test
 - 5. No-load and excitation current at rated voltage on the rated voltage connection

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all equipment per the manufacturer's recommendations and the contract drawings.
- B. Verify the house keeping pad size required and construct as shown or specified.
- C. Securely connect all neutrals and transformer enclosures to ground.

3.02 FIELD ADJUSTMENTS

- A. Adjust taps to deliver appropriate secondary voltage.

3.03 FIELD TESTING

- A. Measure primary and secondary voltages for proper tap settings.

END OF SECTION

SECTION 16470

PANELBOARDS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install panelboard(s) as specified herein and as shown on the Drawings.
- B. The provisions of this Section shall apply to all panelboards, except as indicated otherwise.

1.02 RELATED WORK

- A. Refer to Section 16000 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

- A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 16000, the following:
 - 1. Manufacturers' names and product designation or catalog numbers of all materials specified.
 - 2. Cut sheets for each individual item shall be submitted. Manufacturer's cut sheets and catalog data
 - 3. Breaker arrangement
 - 4. Breaker characteristic curves
 - 5. Instruction for handling and storage
 - 6. Installation instructions
 - 7. Dimensions and weights
- B. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.
- C. Submittals for equipment and materials, furnished under this Section of the Specifications, will not be accepted prior to approval of the Power System Study specified under Section 16105. Submittals made prior to such approval will be returned unreviewed.
- D. Provide systems engineering to produce coordination curves, showing coordination between existing and/or new breakers and/or fuses submitted, such that protective device coordination is accomplished. Such curves and settings shall be included as a part of these submittals.
- E. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will also be returned without review.

F. Shop Drawings and Product Data. The following information shall be submitted to the Engineer:

1. Master drawing index
2. Front view elevation
3. Top view
4. Nameplate schedule
5. UL Listing of the completed assembly
6. Conduit entry/exit locations
7. Assembly ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
8. Major component ratings including:
 - a. Voltage
 - b. Continuous current
 - c. Interrupting ratings
9. Descriptive bulletins
10. Product data sheets.
11. Cable terminal sizes.

G. Operation and Maintenance Manuals.

1. Operation and maintenance manuals shall include the following information:
 - a. Manufacturer's contact address and telephone number for parts and service.
 - b. Instruction books and/or leaflets
 - c. Recommended renewal parts list
 - d. Record Documents for the information required by the Submittals paragraph above.

1.04 REFERENCE CODES AND STANDARDS

- A. The low voltage panelboard assembly and all components in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):
- B. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)
 1. NEMA AB1: Molded Case Circuit Breakers
 2. NEMA PB1: Panelboards

3. NEMA PB1.1: Instruction for Safe Installation Operation and Maintenance of Panelboards rated 600 volts or less.
4. NEMA PB1.2: Application Guide for Ground-fault Protective Devices for Equipment
5. UL 67: Panelboards
6. UL 50: Cabinets and Boxes
- C. Federal Specifications, FS W-C-375A: Circuit Breakers, Molded Case, Branch Circuit and Service.
 1. Fed. Spec W-P-115C
- D. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Article 408 - Switchboards and Panelboards.

1.05 QUALITY ASSURANCE

- A. The manufacturer of this equipment shall have produced similar equipment for a minimum period of ten years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- B. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly. All assemblies shall be of the same manufacturer. Equipment that is manufactured by a third party and "brand labeled" shall not be acceptable.
- C. All components and material shall be new and of the latest field proven design and in current production. Obsolete components or components scheduled for immediate discontinuation shall not be used.
- D. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.
- E. The equipment submitted shall fit within the space shown on the Drawings. The equipment shall not be acceptable otherwise.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

- A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, onsite factory work, or failed factory tests will not be permitted.
- B. Equipment shall be handled and stored in accordance with manufacturer's instructions. Two copies of these instructions shall be included with the equipment at time of shipment and shall be made available to the Contractor and Owner. The instructions shall include detailed assembly instructions including but not limited to wiring interconnection diagrams, rigging for lifting, skidding, jacking, and moving using rolling equipment to place the equipment, bolt torquing requirements for bus

and all other components which require the installation of bolted connections, and instructions for storing the equipment prior to energizing.

- C. Equipment shall be stored indoors and protected from moisture, dust and other contaminants.
- D. Equipment shall not be installed until the location is finished and protected from the elements.

1.07 WARRANTY

- A. Provide warranties, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for three years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

1.08 MEASUREMENT AND PAYMENT

- A. Refer to Section 16000.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable.
 - 1. ABB
 - 2. Eaton
 - 3. Schneider Electric Co
 - 4. Approved equal.
- B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.02 RATINGS

- A. The service voltage, overall short circuit withstand, and interrupting rating of the equipment and components shall be as shown on the Drawings, except that the minimum interrupting rating shall be 22,000 amperes RMS symmetrical for 240/120 volt single- phase or 208Y/120 volt three-phase. The minimum interrupting for 480Y/277 volt three-phase shall be 65,000 amperes RMS symmetrical. Panelboards employing series connected ratings for main, feeder and branch devices are not acceptable and shall not be provided.
- B. Panelboards shall be UL listed and labeled as suitable for use as service equipment.

- C. Where the panelboard is shown or specified to contain a surge protective device (SPD), the complete panelboard, including the SPD, shall be UL67 listed.
- D. Panelboards shall be designed for continuous operation, at rated current, in a 40°C ambient.
- E. For additional ratings and construction notes, refer to the Drawings.

2.03 CONSTRUCTION

A. General

- 1. Refer to the Drawings for actual layout and location of equipment and components, and other required details.
- 2. Provide panelboards manufactured and tested in accordance with NEMA PB 1.
- 3. Provide circuit breakers of industrial grade, manufactured and tested in accordance with NEMA AB 1 and Federal Specification FS W-C-375.
- 4. Perform a load analysis to assure the panel rating is not overloaded when new loads are added to existing panels.
- 5. A nameplate shall be provided listing manufacturer's name, panel type and rating. Nameplates shall be engraved, laminated impact acrylic, matte finish, not less than 1/16-inch thick by 3/4-inch by 2-1/2-inch, Rowmark 322402, or equal. Nameplates shall be 316 SS screw mounted to all enclosures except for NEMA 4 and 4X. Nameplates for NEMA 4 and 4X enclosures shall be attached with double faced adhesive strips, TESA TUFF TAPE 4970, .009 X 1/2 inch, or equal. Prior to installing the nameplates, the metal surface shall be thoroughly cleaned with 70% alcohol until all residues has been removed. Epoxy adhesive or foam tape is not acceptable.

B. Enclosures

- 1. General
 - a. Each enclosure shall be provided with a legend pocket on the inner door.
 - b. Enclosures shall not have holes or knockouts.
- 2. NON-METALLIC
 - a. Chemical Rooms. NEMA 4X constructed as follows:
 - i. PVC or Fiberglass reinforced polyester body and door.
 - ii. UV inhibitors
 - iii. Luggage type quick release latches
 - iv. Foam-in-place gasketed doors
- 3. ALUMINUM
 - a. NEMA 4X Aluminum
 - i. Type 5052 aluminum, body and door

- ii. Stainless steel hinge pins
 - iii. Foam in-place gasket
- 4. NEMA 12
 - a. NEMA 12 Steel
 - i. Mild Steel body and door
 - ii. Stainless steel hinge Pins
- 5. Not otherwise Defined.
 - a. Where an enclosure is not otherwise defined or shown on the Drawing
 - i. NEMA 4X Stainless Steel
 - ii. Type 316 stainless steel, body and door
 - iii. Stainless steel hinges
 - iv. Foam in-place gasket
- 6. NEMA 1 or NEMA 1A
 - a. Where installed indoor with air conditioner space shown on the Drawing
 - i. Mild Steel body and door
 - ii. Stainless steel hinge Pins
- C. Surge Protective Devices (SPDs)
 - 1. Panelboards shown or specified to include an SPD, shall include a Type 2 SPD manufactured by the same manufacturer of the panelboard. Refer to Section 16196 for specifications of the SPDs, and the required submittals to be included under this Section. Submittals not containing the required information in Section 16196 will be returned un-reviewed.
 - 2. The SPD shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs. The SPD shall be interfaced to the panelboard via a direct bus bar connection. The SPD shall be located within the panelboard, unless otherwise shown on the Drawings.
 - 3. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options. See Section 16196 for additional requirements.
- D. Exteriors
 - 1. Unless otherwise noted, all panels shall be designed for surface mounting.
 - 2. Hinged doors covering all circuit breaker handles shall be provided on all panels.
 - 3. Doors shall have semi flush type cylinder lock and catch, except that doors over 48 inches in height shall have a vault handle and three-point latch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Furnish two keys for each lock. All locks shall be keyed alike;

directory frame and card having a transparent cover shall be furnished on each door.

E. Interiors

1. At least four studs for mounting the panelboard interior shall be furnished.
2. Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling, or tapping.
3. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type and all shall be suitable for copper wire of the sizes indicated.

F. Busses

1. All busses, including neutral busses and ground bars, shall be of tin-plated copper. Neutral busses shall be full size. Phase bussing shall be full height without reduction. Cross connectors shall be tin plated copper.
2. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
3. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.
4. Equipment ground bars, of tin-plated copper, shall be furnished.
5. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.

2.04 CIRCUIT BREAKERS

- A. Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.
- B. Circuit breakers shall be molded case, bolt-on type.
- C. Each circuit breaker used in 208Y/120-volt, three phase, or 120/240-volt single phase, panelboards shall have an interrupting capacity of not less than 22,000 amperes, RMS symmetrical.
- D. Each circuit breaker used in 480Y/277 volt and 480-volt panelboards shall have an interrupting capacity of not less than 65,000 amperes, RMS symmetrical.
- E. Provide ground fault interrupters with trip rating where shown on the Drawings.
- F. Circuit breakers shall be as manufactured by the panelboard manufacturer.

2.05 MINI-POWER CENTERS

- A. Mini-power centers shall include a main primary breaker, a dry-type transformer and circuit breaker-type load center in a common NEMA 3R 316 stainless steel enclosure, suitable for indoor/outdoor operation.

- B. kVA and voltage ratings shall be as shown on the Drawings. Main primary breaker shall have an interrupting rating of 65,000 amperes at 480Y/277 volts and a secondary load center rated at 14,000 amperes interrupting capacity (AIC) RMS symmetrical at 120/240 or 208Y/120 volts as shown on the drawings. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:
 - 1. Up to 9 KVA 40 dB
 - 2. 10 to 30KVA 45 dB
- C. Transformer shall be copper wound, 220°C insulation system with a maximum full load temperature rise of 115°C rise. Transformers shall be epoxy-resin encapsulated. The core of the transformer shall be grounded to the enclosure with the neutral wired out to a neutral bus and bonded to a ground bus inside the transformer enclosure. Provide two 5% FCBN taps. All interconnecting wiring between the primary breaker and transformer, secondary main breaker and transformer and load center shall be of copper and factory installed.
- D. Power center shall have phase, neutral and ground tinned copper buses, and be complete with all circuit breakers as shown on the drawings. Breakers for branch circuits shall have an interrupting rating of 14,000 amperes minimum and shall be of the bolt-on type.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Mount boxes for surface mounted panelboards so there is at least 1/2-inch air space between the box and the wall.
- B. Connect panelboard branch circuit loads so that the load is distributed as equally as possible between the phase busses.
- C. Type circuit directories giving location and nature of load served. Install circuit directories in each panelboard.

END OF SECTION

SECTION 16475

LOW VOLTAGE ENCLOSED CIRCUIT BREAKERS AND DISCONNECT SWITCHES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install low voltage enclosed circuit breakers, fused and non-fused disconnect switches, fuses, circuit breakers and appurtenances, complete and operable, as specified herein and as shown on the Contract Drawings.
- B. All equipment specified in this Section of the Specifications shall be the product of one manufacturer and shall be factory constructed and assembled by that manufacturer.

1.02 RELATED WORK

- A. Refer to Section 16000 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

- A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 16000, the following:
 - 1. Manufacturers' names and product designation or catalog numbers of all materials specified.
 - 2. Cut sheets and catalog data for each individual item shall be submitted. Switch internal arrangement.
 - 3. Breaker or fuse characteristic curves.
 - 4. Instructions for handling and storage
 - 5. Dimensions and weights
- B. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.
- C. Submittals for equipment and materials, furnished under this Section of the Specifications, will not be accepted prior to approval of the Power System Study specified under Section 16105. Submittals made prior to such approval will be returned unreviewed.
- D. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will also be returned without review.
- E. The original equipment manufacturer shall create all equipment shop drawings, including all wiring diagrams, in the manufacturer's Engineering department. All equipment shop drawings shall bear the original equipment manufacturers logo, drawing file numbers, and shall be maintained on file in the original equipment

manufacturer's archive file system. Photocopies of the Engineer's ladder schematics are unacceptable as shop drawings.

- F. Submit to the Owner/Engineer, shop drawings and product data, for the following:
1. Product data sheets and catalog numbers for overcurrent protective trip devices on circuit breakers and switches, relaying, meters, pilot lights, etc. The manufacturer's name shall be clearly visible on each cut sheet submitted. List all options, trip adjustments and accessories furnished specifically for this project.
 2. Provide control systems engineering to produce custom unit elementary drawings showing interwiring and interlocking between components and to remotely mounted devices. Include and identify all connecting equipment and remote devices on the schematics. The notation "Remote Device" will not be acceptable. Show wire and terminal numbers. Indicate special identifications for electrical devices per the Drawings.
 3. Provide plan and elevation drawings of each controller or enclosure, with dimensions, exterior and interior views, showing component layouts, controls, terminal blocks, etc.
 4. Schematic diagram
 5. Nameplate schedule
 6. UL Listing of the completed assembly.
 7. Component list with detailed component information, including original manufacturer's part number.
 8. Conduit entry/exit locations
 9. Assembly ratings including:
 - a. Short-circuit rating.
 - b. Voltage
 - c. Continuous current
 10. Major component ratings including:
 - a. Voltage
 - b. Continuous current
 - c. Interrupting ratings
 11. Number and size of cables per phase, neutral if present, ground and all cable terminal sizes.
 12. Key interlock scheme drawing and sequence of operations.
 13. Busway connection and amperage rating.
 14. Instruction and renewal parts books.
- G. Factory Tests. Submittals shall be made for factory tests specified herein.

- H. Field Test Reports. Submittals shall be made for field tests specified herein.
- I. Operation and Maintenance Manuals.
 - 1. Operation and maintenance manuals shall include the following information:
 - a. Manufacturer's contact address and telephone number for parts and service.
 - b. Instruction books and/or leaflets
 - c. Recommended renewal parts list
 - d. Record Documents for the information required by the Submittals paragraph above.
- J. The manufacturer shall submit for approval, a training agenda for all training specified herein. Training agenda shall not be submitted until final approval of the Operation and Maintenance Manual.

1.04 REFERENCE CODES AND STANDARDS

- A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):
- B. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)
 - 1. NEMA Standard AB1 – Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures
 - 2. NEMA KS1: Enclosed Switches
 - 3. NFPA 70 – National Electrical Code (NEC)
 - 4. NFPA 70E – Standard for Electrical Safety in the Workplace
- C. Institute of Electrical and Electronics Engineers (IEEE)
 - 1. IEEE 242 – Protection and Coordination of Industrial and Commercial Power Systems
 - 2. IEEE 399 – Power Systems Analysis
- D. Underwriters Laboratories (UL)
 - 1. UL 98: Standard for safety enclosed switches and Dead Front Switches
 - 2. UL 198C: High Interrupting Capacity Fuses, Current Limiting type
 - 3. UL 198E: Class R Fuses
 - 4. UL 489 – Molded Case Circuit Breakers and Circuit Breaker Enclosures
 - 5. UL 1066 – Low Voltage AC and DC Power Circuit Breakers Used in Enclosures.
- E. All equipment components and completed assemblies specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.05 QUALITY ASSURANCE

- A. The manufacturer of this equipment shall have produced similar equipment for a minimum period of ten years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- B. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly. All assemblies shall be of the same manufacturer. Equipment that is manufactured by a third party and "brand labeled" shall not be acceptable.
- C. All components and material shall be new and of the latest field proven design and in current production. Obsolete components or components scheduled for immediate discontinuation shall not be used.
- D. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.
- E. Equipment submitted shall fit within the space shown on the Drawings. Equipment which does not fit within the space is not acceptable.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

- A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, or equipment which failed any factory tests, will not be permitted.
- B. Equipment shall be handled and stored in accordance with manufacturer's instructions. Two copies of these instructions shall be included with the equipment at time of shipment and shall be made available to the Contractor and Owner. The instructions shall include detailed assembly instructions including but not limited to wiring interconnection diagrams, rigging for lifting, skidding, jacking and moving using rolling equipment to place the equipment, bolt torquing requirements for bus and all other components which require the installation of bolted connections, and instructions for storing the equipment prior to energizing.
- C. Equipment shall be stored indoors and protected from moisture, dust, and other contaminants.
- D. Equipment shall not be installed until the location is finished and protected from the elements.

1.07 WARRANTY

- A. Provide warranties, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner

1.08 MEASUREMENT AND PAYMENT

- A. Refer to Section 16000.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 - 1. Eaton
 - 2. ABB
 - 3. Schneider Electric Co
 - 4. No Equal
- B. Fuses
 - 1. Eaton
 - 2. Ferraz Shawmut Fuses
 - 3. Littlefuse Incorporated
- C. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
- D. All equipment furnished under this Section shall be of the same manufacturer.

2.02 RATINGS

- A. The service voltage shall be as shown on the Drawings. The overall short circuit withstand, and interrupting rating of the equipment and devices shall be equal to or greater than the overall short circuit withstand and interrupting rating of the feeder device immediately upstream of the circuit breaker or switch. Systems employing series connected ratings for main and feeder devices shall not be used.
- B. Circuit breakers, safety switches and associated devices shall be designed for continuous operation at rated current in a 40°C ambient temperature.
- C. Furnish heavy duty Mill rated devices.
- D. For additional ratings and construction notes, refer to the Drawings.

2.03 CONSTRUCTION

- A. General
 - 1. Refer to Drawings for: actual layout and location of equipment and components; current ratings of devices, components; protective relays, voltage ratings of devices, components, and assemblies; and other required details.
 - 2. Furnish lugs for incoming wiring, sizes as shown on the Drawings. Allow adequate clearance for bending and terminating of cable size and type specified,

Lugs for #12 AWG up to #6 AWG shall be ring terminals. Conductors #4 AWG and larger shall be two-hole long barrel lugs with NEMA spacing. All lugs shall be the closed end construction to exclude moisture migration into the cable conductor. See also Section 16120 Wires and Cables (1000 Volt Maximum) for additional requirements.

3. Built in control stations and indicating lights shall be furnished where shown on the Drawings.
4. Furnish nameplates for each device as indicated in Drawings. Nameplates shall be engraved, laminated impact acrylic, matte finish, not less than 1/16-inch thick by 3/4-inch by 2-1/2-inch, Rowmark 322402. Nameplates shall be 316 SS screw mounted to all enclosures except for NEMA 4 and 4X. Nameplates for NEMA 4 and 4X enclosures shall be attached with double faced adhesive strips, TESA TUFF TAPE 4970, .009 X 1/2 inch, or equal. Prior to installing the nameplates, the metal surface shall be thoroughly cleaned with 70% alcohol until all residues has been removed. Epoxy adhesive or foam tape is not acceptable.

B. Enclosures

1. General

- a. Provide 316 SS hardware for all enclosures.
- b. All enclosure doors shall have bonding studs. The enclosure interior shall have a bonding stud.
- c. Enclosures shall not have holes or knockouts for conduit entry.
- d. All panels installed outdoors shall have a factory applied, suitable primer and final coat of weatherproof white paint.
- e. All enclosures shall be provisioned with hardware for a padlock.
- f. All enclosures shall have integral welded mounting lugs or mounting feet. Bolt-on lugs or mounting feet are not acceptable.
- g. See Section 16110 Raceways, Boxes and Fittings for additional requirements.

2. NEMA 7/4X

- a. Class 1, Division 1, Groups A, B, C, and D, or as defined in NFPA 70). Boxes shall be constructed as follows:
 - i. Copper free cast aluminum body and cover
 - ii. Stainless steel hinges
 - iii. Watertight neoprene gasket
 - iv. Stainless steel cover bolts
 - v. All penetrations shall be factory drilled and tapped.

3. NON-METALLIC
 - a. Chemical Rooms. NEMA 4X constructed as follows:
 - i. PVC or Fiberglass reinforced polyester body and door.
 - ii. UV inhibitors
 - iii. Luggage type quick release latches
 - iv. Foam-in-place gasketed doors
4. ALUMINUM
 - a. NEMA 4X Aluminum
 - i. Type 5052 aluminum, body and door
 - ii. Stainless steel hinge
 - iii. Foam in-place gasket
 - iv. Single point quarter turn latches
5. NEMA 12
 - a. NEMA 12 Steel
 - i. Mild steel body and door
 - ii. Stainless steel hinges
 - iii. Foam in-place gasket
 - iv. Single point quarter turn latches
6. NEMA 4X Stainless Steel were not otherwise Defined
 - a. Where an enclosure is not otherwise defined or shown on the Drawing
 - i. NEMA 4X Stainless Steel
 - ii. Type 316 stainless steel, body and door
 - iii. Stainless steel hinge
 - iv. Foam in-place gasket
 - v. Single point quarter turn latches
7. NEMA 1 or NEMA 1A boxes shall not be used.
8. Malleable iron boxes shall not be used.
9. Provide a flange mounted, or through the door, disconnect operating handle with mechanical interlock having a bypass that will allow the enclosure door to open only when the circuit breaker or switch is in the OFF position. The circuit breaker or switch shall have the capability of being bypassed after the door has been opened.

C. Internal Wiring

1. Wiring: Stranded tinned copper, minimum size No. 14 AWG, with 600 Volt, 90°C, flame retardant, Type MTW thermoplastic 600-volt insulation, NEMA Class II, Type B wiring. Line side power wiring shall be sized for the full rating or frame size of the connected device.
2. All wiring shall be tagged and coded with an identification number as shown on the Drawings. Coding shall be typed on a heat shrinkable tube applied to each end showing origination and destination of each wire. The marking shall be permanent, non-smearing, solvent-resistant type like Raychem TMS-SCE, or equal. Wire tags shall be machine-printed. Wire tags relying on adhesives of any type are unacceptable.
3. All wiring shall be neatly bundled with tie wraps and supported to wire way supports. Control wiring shall be bundled separately from power wiring. In addition, low signal wiring (millivolt and milliamp) shall be bundle separately from the rest of the control wiring.

D. Field Installed Internal Wiring

1. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed. In addition, low signal wiring (millivolt and milliamp) shall be bundle separately from the rest of the control wiring. Wiring shall not be supported using adhesive supports. Adhesive wire supports are unacceptable, and if installed shall be removed and replaced with a non-adhesive support with no increase in Contract Price or Time.
2. All field wiring shall be tagged and coded with an identification number. Coding shall be typed on a heat shrinkable tube applied to each end of the wire. The marking shall be a permanent, non-smearing, solvent-resistant type like Raychem TMS-SCE, or equal. Wire tags shall be machine-printed. Wire tags relying on adhesives of any type are unacceptable.
3. In general, all conduit entering or leaving equipment shall be stubbed up into the bottom of the enclosure directly below the area in which the conductors are to be terminated, or from the top if shown on the Drawings and not located in a wet, damp or any process area. Conduits shall not enter the side unless approved in writing by the Owner/Engineer.

2.04 CIRCUIT BREAKERS

A. Insulated Case Circuit Breakers (ICCBs)

1. Unless otherwise shown on the Drawings, circuit breakers, larger than a 1200 ampere rating, shall be insulated case (ICCB), three-ole, 600 volt, fixed type, with stored energy closing mechanism.
2. Breakers shall be manually operated unless indicated as electrically operated (EO) on the Drawings.

3. Electrically operated breakers shall be complete with [close/open pushbuttons or a control switch, as shown on the Drawings, with red and green indicating lights to indicate breaker contact position, and 120-volt AC motor operators.
4. All insulated case circuit breakers shall have a minimum symmetrical interrupting capacity of 42,000 amperes, with individual interrupting capacity as shown on the Drawings. Insulated case circuit breakers without an instantaneous trip element adjustment shall be equipped with a fixed internal instantaneous override set at the upper limit.
5. All insulated case circuit breakers shall be constructed and tested in accordance with UL 489. The circuit breakers shall carry a UL label.
6. All insulated case circuit breakers shall have an adjustable long-time pickup, and delay; adjustable short time pickup and delay; short time i²t switch; high range instantaneous (fixed at the breaker's short-time withstand rating), adjustable ground fault pickup and delay; ground fault delay and pickup trips for selective tripping], and overload, short circuit, and ground fault indicator lights.

B. Molded Case Circuit Breakers (MCCB's)

1. Unless otherwise shown on the Drawings, circuit breakers 225 ampere frame rating and larger, shall be molded case (MCCB), three-Pole, 600-volt, fixed type, with stored energy closing mechanism. Breakers shall be manually operated unless indicated as electrically operated (EO) on the Drawings. Trip device shall be solid state with adjustable long time pickup, and delay; adjustable short time pickup and delay; short time i²t switch; adjustable instantaneous pickup, adjustable ground fault pickup and delay, and ground fault delay and pickup trips for selective tripping.
2. Unless otherwise shown on the Drawings, circuit breakers less than 225 ampere frame rating shall be molded case, three-Pole, 600-volt, fixed type, manually operated with stored energy closing mechanism. Circuit breakers shall have inverse time and instantaneous tripping characteristics.
3. Where shown on the Drawings or specified in the Contract Documents, breakers shall be rated for 100% continuous duty, and shall carry a UL 489 listing.

2.05 DISCONNECT SWITCHES

- A. Disconnect switches shall be heavy duty, quick make, quick break, visible blades, 240-volt or 600-volt, two-pole or three-pole as shown in contract documents with full cover interlock, interlock defeat and flange mounted operating handle.

2.06 FUSED DISCONNECT SWITCHES

- A. Fused disconnect switches shall be heavy duty, quick make, quick break, visible blades, 240volt or 600 volt, two or three-pole with full cover interlock, interlock defeat and flange mounted operating handle.
- B. Fuses shall be rejection type, 600 volts, 200,000 A.I.C., dual element, time delay, Bussman Fusetron, Class RK 5 or equal.

2.07 MOTOR ISOLATION SWITCHES

- A. For motors up to and including 100 horsepower, the isolating switch shall be a horsepower rated, quick make, quick break, visible blades, 600 volt, three pole motor circuit switch, in an enclosure as listed above and sized for the motor as shown on the Drawings. The switch shall be plainly marked “Do not operate under load”.
- B. For motors greater than 100 horsepower, the isolating switch shall be a current rated, quick make, quick break, visible blades, 600-volt, three pole motor circuit switch, in an enclosure as listed above and sized for the motor as shown on the Drawings. The switch shall be plainly marked “Do not operate under load”.
- C. Where a switch status auxiliary contact is shown on the Drawings, the auxiliary contact shall be early break (opens before the switch is opened) and early make (closes before the switch is closed). The auxiliary contact shall be rated 5 amperes at 480 volts.

2.08 SPARE PARTS

- A. Provide the following spare parts:
 - 1. Three – Fuses of each type used.
- B. Spare parts shall be boxed or packaged for long term storage and clearly identified on the exterior of package. Identify each item with manufacturers name, description and part number.

2.09 FACTORY TESTING

- A. The circuit breakers and disconnects shall be completely assembled, wired, and adjusted at the factory and shall be given the manufacturer’s routine shop tests and any other additional operational test to insure the workability and reliable operation of the equipment.
- B. Factory test equipment and test methods shall conform with the latest applicable requirements of ANSI, IEEE, UL, and NEMA standards, and shall be subject to the Owner/Engineer’s approval.

PART 3 EXECUTION

3.01 INSTALLER’S QUALIFICATIONS

- A. Installer shall be specialized in installing low voltage circuit breakers and disconnect switches with minimum five years documented experience. Experience documentation shall be submitted for approval prior to beginning work on this project.

3.02 EXAMINATION

- A. Examine installation area to assure there is enough clearance to install the equipment.
- B. Verify that the equipment is ready to install.

- C. Verify field measurements are as instructed by manufacturer.

3.03 INSTALLATION

- A. Install all equipment per the manufacturer's recommendations and Contract Drawings.
- B. Install required safety labels.
- C. Conduit entry into the top of any NEMA 4/4X rated enclosure in any outdoor, damp, wet or process area is strictly prohibited. Any enclosure entered from the top will be removed and replaced, the conduit and conductors re-routed, or conductors replaced if too short. No increase in Contract Price or Contract Time will be allowed.

3.04 FIELD QUALITY CONTROL

- A. Inspect installed equipment for anchoring, alignment, grounding, and physical damage.
- B. Check tightness of all accessible electrical connections. Minimum acceptable values are specified in manufacturer's instructions.

3.05 FIELD ADJUSTING

- A. Adjust all circuit breakers, switches, access doors, operating handles for free mechanical and electrical operation as described in manufacturer's instructions.
- B. The Power Monitoring and Protective Devices shall be set in the field by a qualified representative of the manufacturer in accordance with settings designated in a coordinated study of the system as required in Section 16105 Power System Study. All such settings, including the application of arc flash labels, shall have been made and Approved by the Owner/Engineer, prior to energizing of the equipment.

3.06 FIELD TESTING

- A. Perform all electrical field tests recommended by the manufacturer. Disconnect all connections to solid-state equipment prior to testing.
- B. Megger and record phase to phase and phase to ground insulation resistance. Megger, for one minute, at minimum voltage of 1000 volts DC. Measured Insulation resistance shall be at least 100 megohms. In no case shall the manufacturer's maximum test voltages be exceeded.
- C. Test the ground fault protection system using a high current injection method.
- D. Test the rating plug for correct rating.

3.07 CLEANING

- A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.08 EQUIPMENT PROTECTION AND RESTORATION

- A. Touch-up and restore damaged surfaces to factory finish, as approved by the manufacturer. If the damaged surface cannot be returned to factory specification, the surface shall be replaced.

END OF SECTION

SECTION 16481
MOTOR CONTROLLERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. AC motor control devices rated 600 v and below.
- B. Overcurrent protective devices and disconnect switches used with motor controllers are specified in Section 16475 – Overcurrent Protective Devices.

1.02 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum base bid.

1.03 RELATED SECTIONS

- A. Specification 16195 - Electrical Identification.

1.04 DEFINITIONS

- A. Motor Controller: Device that controls, protects, and energizes electric motor, and where required, controls its speed or torque or power delivered by it.

1.05 SUBMITTALS

- A. Submit all products covered under this section for Engineer's approval.

1. Product Data:

- a. Include dimensions, ratings, and data on features and components.

2. Test Results:

- a. Certified reports of field tests and observations.

3. Miscellaneous:

- a. 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.

4. Operation and Maintenance (O&M) Data:

- a. Manufacturer's data on maintenance and operation of equipment.

1.06 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain similar motor-control devices from single manufacturer.

B. Manufacturer Qualifications:

1. Provide controllers from manufacturers regularly engaged in manufacture of equipment of types and capacities indicated, with such products in satisfactory use in similar service for not less than 5 yrs.

C. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

D. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) No. 70.

1.07 COORDINATION

- 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.

1.08 MAINTENANCE

A. Extra Materials:

1. Spare Fuses, Indicating Lamps and Lenses: Furnish one spare for every 5 installed units, but not less than one set of 3 of each kind.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manual and Magnetic Motor Controllers:

1. Eaton
2. General Electric/ ABB
3. Schneider/ Square D

2.02 MOTOR CONTROLLERS, GENERAL

- 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 on the contract drawings. 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 where located.

2.03 MANUAL MOTOR CONTROLLERS

- A. Quick-make, quick-break toggle action.
- B. Doublebreak silver alloy contacts.
- C. Pilot light.
- D. Padlocking provision.

2.04 MAGNETIC MOTOR CONTROLLERS

- A. Full voltage, non-reversing, across-the-line, magnetic controller, except where another type indicated on the drawings.
- B. Control Circuit: 120V. Control power transformer integral with controller where no other supply of 120 v control power to controller indicated. Control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
- C. 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.

2.05 AUXILIARY CONTROL DEVICES

- A. General: Furnish auxiliary control device as shown on 1 line diagrams, Drawings, or as specified. Factory-install in controller enclosure except as otherwise indicated.
- B. Pushbutton Stations, Pilot Lights, and Selector Switches: 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.
- 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.
- E. Control Relays: Heavy duty industrial type auxiliary and adjustable time-delay relays.
- F. Elapsed Time Meters: Heavy duty with digital readout in hrs.
- G. Current Sensors: Rated to suit application.
- H. Pilot Lights: High intensity LED type lamp.

PART 3 EXECUTION

3.01 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 rack, hot dip galvanized after fabrication with Type 316 SS strut for cross support. Use feet consisting of min. 3/8 inch thick steel plates, 8 inch square, bolted to floor. Use feet for welded attachment of 1 1/2-inches by 1-1/2-inches by 1/4-inch vertical angle posts not over 3 feet oc. Connect posts with horizontal lightweight slotted steel channels and bolt control equipment to channels.
 - 3. Unless shown otherwise on plans.
- C. Motor Controller Fuses and Circuit Breakers: Conform to requirements of Section 16475 – Overcurrent Protective Devices.

3.02 IDENTIFICATION

- A. Comply with Section 16195 – Electrical Identification.

3.03 CONTROL WIRING INSTALLATION

- A. Install wiring as specified in Section 16120 – 600 Volt Insulated Wire.
- B. Install wiring in enclosures bundled, trained, and supported.

3.04 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 torquing

requirements not indicated, comply with tightening torques specified in UL 486A and 486B.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. 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:
 - a. 1/2 man day 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 manufacturers 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 30V unacceptable.
5. Correct deficiencies and retest motor control devices. Verify by system tests that specified requirements are met.

3.06 CLEANING

- A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marks of finish to match original finish. Clean devices internally using manufacturer's recommended methods and materials.

END OF SECTION

SECTION 16600
UNDERGROUND SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install a complete underground system of raceways, manholes and handholes as shown on the Drawings and as specified herein.
- B. Raceways for use in structural concrete is specified in Section 16110 Raceways, Boxes and Fittings.

1.02 RELATED WORK

- A. Refer to Section 16000 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

- A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 16000, the following:
 - 1. Manufacturers' names and product designation or catalog numbers of all materials specified.
 - 2. Cut sheets for each individual item shall be submitted.
 - 3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.
- B. Submit to the Engineer, shop drawings and product data, for the following:
 - 1. Manholes, handholes and associated hardware.
 - 2. Plastic duct spacers.
 - 3. Submit the calculated pulling tensions to the Engineer for approval prior to beginning the installation.
 - 4. Submit the recorded pulling tensions for each pull as specified.
- C. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will be returned unreviewed.

1.04 REFERENCE CODES AND STANDARDS

- A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):
 - 1. NFPA 70 – National Electrical Code (NEC)
 - 2. NFPA 70E – Standard For Electrical Safety in the Workplace

3. ASTM A615/A615M-06a – Standard Specification for Deformed and Plain Carbon-Steel Bars for concrete Reinforcement
4. ASTM A48 – Standard Specification for Gray Iron Castings
5. ASTM A536 - Standard Specification for Ductile Iron Castings
6. AASHTO M306-04/ ASTM A48 – Drainage Structure Castings, Section 7.0 Proof Load Testing
7. ASTM C-850- Specifications for underground precast concrete utility structures
- B. All excavation, trenching, and related sheeting, bracing, etc., as shown on the Drawings, and listed in these Specifications, shall comply with the following standards (unless otherwise noted):
 1. Occupational Safety and Health Administration (OSHA)
 - a. Excavation safety standards (29 CFR Part 1926.650 Subpart P) - Excavation.
 2. American Society for Testing and Materials (ASTM)
 - a. ASTM D 698a – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600kN-m/m³)).
- C. All equipment components and completed assemblies specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.05 QUALITY ASSURANCE

- A. The manufacturer of these materials shall have produced similar electrical materials and equipment for a minimum period of five years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- B. The precast manholes shall be manufactured in a NPCA (National Precast Concrete Association) Certified Plant.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

- A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, onsite factory work, or failed factory tests will not be permitted.
- B. Materials shall be handled and stored in accordance with manufacturer's instructions.
- C. Materials shall not be stored exposed to sunlight. Such materials shall be completely covered.
- D. Materials showing signs of previous or jobsite exposure will be rejected.

1.07 WARRANTY

- A. Provide warranties, including the manufacturer's warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and

workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided by the Manufacturer. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.

1.08 MEASUREMENT AND PAYMENT

A. Refer to Section 16000.

PART 2 PRODUCTS

2.01 MATERIALS

A. Raceway System

1. The criteria specified in Section 16110 Raceways, Boxes, Enclosures and Fittings shall apply to this section.
2. Raceway system shall be Schedule 80 PVC Rigid Nonmetallic Conduit (RNC), designed for use aboveground and underground as described in the NEC, resistant to sunlight. The conduits and fittings shall be manufactured to NEMA TC-2, Federal Specification WC1094A and UL 651 specifications. Minimum raceway size shall be 2 inch. Fittings shall be manufactured to NEMA TC-3, Federal Specification WC1094A and UL 514B. Conduit shall have a UL Label. Conduit shall be Carlon, Kraloy, or approved equal.
3. PVC coated rigid aluminum conduit shall have a minimum 0.040-inch thick, polyvinyl chloride coating permanently bonded to rigid aluminum conduit and an internal chemically cured urethane or enamel coating. The ends of all couplings, fittings, etc. shall have a minimum of one pipe diameter in length of PVC overlap. PVC coated conduit and fittings shall be as manufactured by Perma-Cote, Robroy Industries, Calbond or Ocal, or approved equal. Any field bends shall be made using equipment designed to prevent damage to the PVC coating.
4. All underground raceways of the underground system, terminating in manholes or handholes shall use terminators of the same size and type as the raceway.
5. Blank Duct Plugs shall be sized for the duct installed on and shall be TYCO Type JM-BLA-XXDXXXCR, with rubber gasket, or approved equal.
6. Duct spacers shall be as manufactured by Carlon or approved equal.
7. Where raceways terminate into existing and new manholes, handholes or structures, the duct bank steel shall be anchored into the manhole, handhole or structure with a Hilti HIT 150 MAX epoxy anchoring system, or approved equal. The termination of the duct bank steel shall utilize a minimum 24-inch length of reinforcing bar anchored not less than four inches into the manhole, handhole or structure wall, and lapped into each reinforcing bar in the duct bank.
8. Concrete encasement for raceways and duct banks shall be normal weight concrete weighing not more than 145 pounds per cubic foot with compressive strength, a minimum of 3000 pounds per square inch, or greater if required by

other Divisions of the Specifications, at 28 days, Concrete shall have crushed aggregate with a maximum size of 3/4-inch, a slump of four to six inches and flow freely without the use of vibrators. Install red dye of 40 pounds per 10 cubic yards of concrete, installed in the truck at the concrete plant.

9. Reinforcing steel shall comply with ASTM A615 Grade 60 and of a size and installation as shown on the Drawings.

B. Manholes and Handholes

1. General

- a. Manholes and handholes shall be of the precast concrete type, designed for a Class H20 load with sizes as shown on the Drawings, and as manufactured by Oldcastle Precast, Mansfield, TX, or approved equal.

2. Construction

- a. Concrete for manholes and handholes shall have a 28-day compressive strength of 5000 PSI. Cement shall be Type 1 or III. Reinforcing steel shall be Grade 60 with minimum yield strength of 60,000 PSI. Design loadings shall be H-20-44 w/impact.
- b. The top of all manholes shall be field removable and have stainless steel lifting eyes.
- c. Duct bank entries into the manhole or handhole shall be centered on the entering wall unless otherwise shown or specified.
- d. Cables shall be secured to racks along the walls such that cables are not routed below any access opening.
- e. Manholes in medium voltage systems shall have the duct banks enter on the wall such that the routing and securing of the cables shall be made so that they do not pass under any access opening and the minimum bending radius of the cable is not less than allowed.
- f. The duct bank entering the manhole shall contain the appropriate number and size of duct terminators to match the corresponding duct bank.
- g. Each manhole and handhole shall have a minimum size of 1-inch\ by 12 inch by 2-inch-deep concrete sump in the middle of the floor of the manhole or handhole, or as shown on the Drawings.

3. Manhole Covers

- a. Unless otherwise shown on the Drawings, manhole and handhole covers shall be heavy duty 36-inch machined gray iron, and AASHTO M306-04/ ASTM A48 CL35B Minimum, 40,000-pound proof load value (Class H20 X 2.5) "True Traffic" load covers, complete with frame, and "Electric" or "Communication" raised lettering recessed flush, as required, on the cover. Covers shall be V-1600-5, with drop handles as manufactured by East Jordan Iron Works, Ardmore, OK, or approved equal.

- b. All castings shall be made in the USA, cast with the foundry's name, part number, "Made in USA", and production date (example: mm/dd/yyyy). Castings without proper markings will be rejected. Manufacturer shall certify that all castings conform to the ASTM and AASHTO Designations as specified herein. All casting shall be true to pattern in form and dimension, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting strength and value for the service intended. Angles shall be filleted and arises shall be sharp and true.
4. Access Hatch
- a. Where access hatches are shown on the Drawings, hatches shall be heavy duty aluminum, for H-20 load rating, sized as shown on the Drawings. Hatches shall be CHS Series as manufactured by East Jordan Iron Works, Ardmore, OK or approved equal.
 - b. Material shall be 6061-T6 aluminum for bars, angle, and extrusions. 1/4-inch diamond plate shall be 5066 aluminum.
 - c. Unit shall have a heavy-duty pneumatic spring, for ease of operation when opening cover. Cover shall be counter-balanced so that one person can easily open the hatch door.
 - d. Frame shall be of extruded aluminum with a continuous 1-1/4-inch anchor flange. A dovetail groove shall be extruded into the seat of the frame with a 1/8" silicone gasket.
 - e. Hinges shall be of heavy-duty design, the material shall be grade 316 stainless steel, with a 3/8-inch grade 316 stainless steel pin. Hinge shall be bolted to the channel frame and diamond plate with grade 316 stainless steel bolts and nylon lock nuts. Aluminum shall be supplied with mill finish. Exterior of frame which contacts concrete shall have one coat black primer.
 - f. Each hatch shall be supplied with a stainless-steel slam lock, with the keyway protected by a threaded aluminum plug. The plug shall be flush with the top of the 1/4-inch diamond plate. The slam lock shall be fastened with grade 316 stainless steel bolts and washers.
 - g. Each hatch shall be equipped with a stainless-steel lift handle. Lift handles shall be flush with top of 1/4-inch diamond plate.
 - h. Each hatch shall be supplied with a 1-1/2-inch threaded drain coupler on underside of channel frame for pipe connection.
5. Hardware
- a. Cable racks shall be of the heavy-duty non-metallic type with arm lengths of 8 inches, 14 inches, and 20 inches, each supporting a load of not less than 250 pounds at the outer end. Racks shall be molded in one piece of U.L. listed glass reinforced nylon, Catalog CR36N with RA08N, RA14N and RA20N arms as manufactured by Underground Devices Inc. Northbrook, IL or approved equal. Cable racks shall be secured to the manhole and walls by drilled, Hilti HIT-HY 150 MAX epoxy anchoring system, with Hilti 316

stainless steel bolts. Arms for racks shall be vertically spaced not greater than 24 inches on centers.

- b. Pulling irons shall be of copolymer polypropylene coated 1/2-inch diameter cable, with a rated pulling strength of 7500 pounds and a polyethylene pulling iron pocket, all recessed in the manhole wall opposite each duct entry. Pulling irons for handholes shall have the pulling iron located in the floor of the handhole near the center of the handhole opposite the duct entry. Pulling irons shall be as manufactured by M.A. Industries, Inc. Peachtree, GA. or Bowco Industries, Portland OR or approved equal.
- c. Manhole and handhole ladders shall be constructed of fiberglass reinforced plastic, safety yellow, 18-inch rung width with 12-inch rung spacing, Safrail as manufactured by Strongwell Corp., Bristol, VA or approved equal. Furnish a total of two ladders, each of a length four feet greater than the deepest manhole in the underground system.

C. Polyethylene Warning Tape

- 1. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 - a. Brady Detectable Identoline
 - b. Approved Equal
- 2. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
- 3. Warning tape shall be metal detectable polyester with subsurface graphics, black letters on red tape. The tape shall meet the OSHA 1926.956(c)(1), two-inch minimum width, for location tracing.

PART 3 EXECUTION

3.01 GENERAL

- A. Field verify the routing of all underground duct banks before placement. Modify the routing as necessary to avoid underground utilities or above ground objects. Modification or rerouting for convenience, or to reduce the length of duct run as designed, will not be permitted. Provide any alternate routing of the duct banks to the Owner/Engineer and, after approval, shall proceed with the installation.
- B. All changes of direction, less than 20 degrees, shall be made using a hotbox, strictly in conformance with the conduit manufacturer's instructions. Changes of direction greater than 20 degrees shall be accomplished using long radius bends of PVC coated rigid aluminum conduit.
- C. Saw cut and repair existing pavements above new and modified existing duct banks. Provide the alternate routing of the duct banks to the Owner/Engineer and after approval shall proceed with the installation.

- D. Install raceways to drain away from buildings. Raceways between manholes or handholes shall drain toward the manholes or handholes. Raceway slopes shall not be less than 3 inches per 100 feet.
- E. Reinforce raceway banks as shown on the Drawings.
- F. A #4/0 stranded bare tinned copper ground conductor shall be installed along the top of the rebar cage, as shown on the Drawings, for the full length of each duct run between manholes and handholes and bonded to a ground rod in the vicinity of each manhole and handhole.
- G. Lay raceway lines in trenches on compacted earth as specified herein.
- H. Use plastic spacers located not more than four feet apart to hold raceways in place. Spacers shall provide not less than two-inch clearance between raceways.
- I. Assemble duct banks using non-magnetic saddles, spacers, and separators. Position separators to provide 2-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. Make a transition from non-metallic to PVC-coated metallic rigid aluminum conduit where duct banks enter structures or turn upward for continuation above grade.
- L. The minimum cover for raceway banks shall be 24 inches unless otherwise permitted by the Owner/Engineer.
- M. Raceway entering manholes both existing and new shall be terminated with bell end terminators installed flush with the manhole wall unless otherwise shown, specified, or approved by the Engineer.
- N. Blank duct plugs shall be used to seal the ends of all unused ducts in the duct system. Plugs shall be installed at all locations where the ducts enter and leave the manholes or handholes, and all entrances and exits to the underground system.
- O. Raceways entering or exiting the Underground System, and raceways rising to a higher elevation upon entering or leaving the System, shall be tightly sealed at the higher elevation, both before and after the installation of cables, T there shall be no entry of water or moisture to the Underground System at any time. Raceways shall be sealed with 3M 1000NS Watertight Sealant or approved equal.
- P. No wire shall be pulled until the duct system has been completed in every detail.
- Q. Swab all raceways clean before installing cable.
- R. Train cables in manholes and handholes and support and restrain them on cable racks. All cables passing manhole duct entrances in the manhole or handhole shall pass above all duct entrances. No cable shall pass in front of or below duct bank entrances.

1. The location of various conductors shown on duct bank cross section details are not to be taken latterly in all cases. Reorganization of the cables in the various duct bank ducts to different locations in the duct bank to facilitate bundling of the different types of cables as they pass through the manhole or hand hole to isolate analog and other low voltage signal cables from all other cables that carry AC voltages is permitted.
2. No cables shall pass under the access hatch or opening to the manhole or hand hole.
3. Ducts routing medium voltage cables entering manholes or handholes may be allowed to enter off center close to adjoining walls will be permitted to facilitate the routing and racking the cables through the manholes to avoid violating the allowed minimum bending radius.
4. Duct banks carrying low voltage cables larger than 350 kcmil, may also enter manholes or handholes off center to facilitate routing and racking.
- S. Polyethylene Warning Tape shall be installed in the trench above each raceway or duct bank and located at the elevations shown on the Drawings.
- T. Tag all underground conduits at all locations, exiting and entering from underground, including manholes and handholes, with stamped, stainless steel tags. Identify as designated in cable and conduit schedule.
- U. The minimum raceway size shall be 2-inch unless otherwise shown on the plans.

3.02 PULLING TENSIONS

- A. Calculate the pulling tensions for each direction of pull for each of the cables in each duct prior to the installation of the conductors. Submit the calculations to the Engineer prior to starting the installation of the conductors.
- B. All installations that are not done by hand which require mechanical pulling machines shall be monitored. The maximum pulling tension recorded for each pull shall be recorded and submitted to the Owner and Engineer for record.
- C. Conductors or cables installed by machine for which no pulling tensions were submitted prior to beginning the installation or are installed by machine without the pulling tensions being recorded shall be removed and replaced with no change in the Contract Price or Schedule.

3.03 TRENCH EXCAVATION

- A. The excavation shall extend to the width and depth as shown on the Drawings, or as specified, and shall provide suitable room for installing manholes, handholes, ducts and appurtenances.
- B. Furnish and place all sheeting, bracing and supports.
- C. Excavation shall include material of every description and of whatever substance encountered, regardless of the methods or equipment required to remove the material. Pavement shall be cut with a saw, wheel, or pneumatic chisel along straight lines before excavating.

- D. Strip and stockpile topsoil from grassed areas crossed by trenches. Topsoil may be otherwise disposed of and replaced, when required, with approved topsoil of equal quality.
- E. While excavating and backfilling is in progress, traffic shall be maintained, and all utilities and other property protected, as provided for in the Contract Documents.
- F. Materials shall be excavated to the depth indicated on the Drawings and in widths sufficient for installing manholes and laying the ducts. Coordinate the trench width the Details shown on the Drawings. The bottom of the excavations shall be firm and dry in all respects acceptable to the Owner/Engineer. Trench width shall be a practical minimum, but not less than 6 inches greater on each side, than the total duct section arrangement, including reinforcing steel.
- G. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of sub grade soils. The trench may be excavated by machinery to, or just below, the designated sub grade, if material remaining in the bottom of the trench is no more than slightly disturbed. Sub grade soils which become soft, lose or otherwise unsatisfactory because of inadequate excavation, dewatering or other construction methods, shall be removed and replaced by gravel fill, of aggregate as specified herein, as required by the Owner/Engineer with no change in the Contract Price or Scheduled allowed.

3.04 EXCAVATION BELOW GRADE AND REFILL

- A. Regardless of the nature of unstable material encountered, or the groundwater conditions, trench and excavation drainage shall be complete and effective.
- B. If deemed necessary by the Owner/Engineer, or as shown on the Drawings, pea gravel shall be added for duct bedding or gravel refill for excavation below grade, directly on the bottom of the trench immediately after excavation has reached the proper depth and before the bottom of the trench has become softened or disturbed by any cause whatsoever. All excavation shall be made in open trenches. Gravel used for this purpose, shall be aggregate, as specified that is no larger than one-half the minimum clear spacing between electrical ducts, and a maximum coarse aggregate size of 3/4-inch.

3.05 BACKFILLING

- A. Remove from the excavation all materials which the Owner/Engineer may deem unsuitable for backfilling.
- B. Backfilling shall not commence until, not less than 48 hours after placing of any concrete embedment, have lapsed.
- C. Where the duct banks are laid in the yard, the remainder of the trench, after concrete encasement, shall be filled with common fill material, void of rock or other non-porous material, in layers not to exceed eight inches in loose measure and compacted to 90% standard Proctor density at optimum moisture content of +/- 4%. The backfill shall be mounded six inches above the existing grade or as directed by the Owner/Engineer. Where a grass, loam or gravel surface exists prior to excavations in the yard, it shall be removed, conserved, and replaced to the full

original depth as part of the work under the duct items. In some areas, it may be necessary to remove excess material during the cleanup process, so that the ground may be restored to its original level and condition.

- D. Where the duct banks are laid in paved areas or designated future paved areas, existing or designated future structures, or other existing or future utilities, the remainder of the trench above the encasement, shall be backfilled with select common fill or select fill material in layers not to exceed eight inches loose measure and compacted at optimum moisture content (+/- 3%) to 95% standard Proctor density.
- E. Compaction shall be by use of hand or pneumatic tamping with tools weighing at least 20 pounds. The material being spread and compacted shall be placed in layers not over eight inches loose thick. If necessary, sprinkling shall be employed in conjunction with rolling or ramming.
- F. Bituminous paving shall not be placed in backfill.
- G. Water jetting will not be accepted as a means of consolidating or compacting backfill.
- H. All road surfaces shall be broom finished and hose-cleaned immediately after backfilling. Dust control measures shall be always employed.

3.06 RESTORING TRENCH AND ADJACENT SURFACES

- A. In paved areas, the edge of the existing pavement to be removed shall be cut along straight lines, and the pavement replaced with the same type and quality of the existing paving.
- B. In sections where the duct bank passes through grassed areas, remove and replace the sod, or provide loam and reseed the surface to the satisfaction of the Owner/Engineer.

3.07 CLEANING

- A. Remove all rubbish and debris from inside and around the underground system. Remove dirt, dust, or concrete spatter from the interior and exterior of manholes, handholes and structures, using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

END OF SECTION

SECTION 16660
GROUNDING AND BONDING SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install a complete Grounding and Bonding System, in strict accordance with Article 250 of the National Electrical Code (NEC), and as shown on the Drawings and specified herein.
- B. The system shall include ground wires, ground rods, exothermic connections, mechanical connectors, structural steel connections, all as shown on the Drawings, and as specified herein, to provide a bonding to earth ground of all metallic materials likely to become energized.
- C. Include the following:
 - 1. Grounding electrodes and conductors
 - 2. Equipment grounding conductors
 - 3. Bonding
 - 4. Power system grounding
 - 5. Communication system grounding
 - 6. Electrical equipment and raceway grounding and bonding
 - 7. Control equipment grounding
 - 8. Soil resistivity measurements
 - 9. Grounding system resistance to earth measurements

1.02 RELATED WORK

- A. Refer to Section 16000 and the Contract Drawings, for related work and electrical coordination requirements.

1.03 SUBMITTALS

- A. Submit to the Owner/Engineer, in accordance with Division 1 and Section 16000, the following:
 - 1. Manufacturers' names and product designation or catalog numbers of all materials specified.
 - 2. Cut sheets for each individual item shall be submitted.
 - 3. Each cut sheet shall be clearly marked to indicate the item submitted and/or mark out items which are not being submitted for approval. Submittals not clearly marked will be returned with the indication REVISE AND RESUBMIT as a minimum or other indication per the specifications as warranted.

- B. Submit to the Engineer shop drawings and product data, for the following:
1. Ground rods.
 2. Grounding conduit hubs.
 3. Waterpipe ground clamps.
 4. Buried grounding connections.
 5. Compression lugs.
 6. Exothermic bonding system.
 7. Manufacturer's cut sheets and catalog data
 8. Installation, terminating and splicing procedure.
 9. Instruction for handling and storage
 10. Dimensions and weight
 11. Soil resistivity measurements for each structure having a counterpoise grounding system and for each structure having a lighting protection system specified or shown to be installed.
 12. Grounding system resistance to earth measurements for each structure having a counterpoise grounding system and for each structure having a lighting protection system specified or shown to be installed.

1.04 REFERENCE CODES AND STANDARDS

- A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):
1. American Society for Testing and Materials (ASTM)
 - a. ASTM B3: Soft or Annealed Copper Wires
 - b. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft
 - c. ASTM B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes
 2. Institute of Electrical and Electronics Engineers (IEEE)
 - a. IEEE 142-82: Recommended Practice for Grounding of Industrial and Commercial Power Systems
 - b. IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.
 - c. Underwriters' Laboratories (UL)
 3. UL 83: Thermoplastic Insulated Wire and Cables
 - a. UL 467: Grounding and Bonding Equipment

4. National Fire Protection Association (NFPA)
 - a. NFPA No. 70 - National Electrical Code (NEC), Article No. 250 - Grounding.
 - b. NFPA 70 – National Electrical Code (NEC)
 - c. NFPA 70E – Standard for Electrical Safety in the Workplace
 - B. All equipment components and completed assemblies specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.
- 1.05 QUALITY ASSURANCE
- A. The manufacturer of these materials shall have produced similar electrical materials and equipment for a minimum period of five years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
 - B. Tests
 1. Use insulated cable conforming to requirements of the vertical tray flame test as described in IEEE 383-2.5.
 2. Test grounding system in the field in accordance with procedures outlined in Part 3 – Execution.
- 1.06 JOBSITE DELIVERY, STORAGE AND HANDLING
- A. Prior to jobsite delivery, complete all submittal requirements, and present to the Owner/Engineer prior to delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, onsite factory work, or failed factory tests will not be permitted.
 - B. Protect equipment during shipment, handling, and storage by suitable complete enclosures. Protect equipment from exposure to the elements and keep thoroughly dry.
- 1.07 WARRANTY
- A. Provide warranties, including the manufacturer’s warrantee, for the equipment specified and the proper installation thereof, to be free from defects in material and workmanship for two years from date of final acceptance of the equipment and its installation. Within such period of warranty, all material and labor necessary to return the equipment to new operating condition shall be provided. Any warranty work requiring shipping or transporting of the equipment shall be provided at no expense to the Owner.
- 1.08 MEASUREMENT AND PAYMENT
- A. Refer to Section 16000.
- PART 2 PRODUCTS
- 2.01 RACEWAYS
- A. Conduit shall be provided as specified under Section 16110.

- B. All raceways, conduits and ducts shall contain equipment grounding conductors sized in accordance with the NEC. Minimum size of the grounding conductors shall be #12 AWG unless otherwise indicated on the drawings. Equipment grounding conductors larger than the NEC minimums shall be provided as shown on the drawings.

2.02 CONDUCTORS

- A. Conductors shall be as specified under Section 16120.
- B. Equipment grounding conductors shall be tinned insulated XHHW-2 conductors. Conductors shall be green where available from the wire manufacturers or marked with green tape as specified under 16120.
- C. Grounding electrode conductors shall be bare tinned copper where direct buried or encased in concrete. Bare grounding electrode conductors or lightning protection conductors where exposed to damage shall be installed in conduit. Grounding electrode conductors or lightning protection down lead conductors shown, specified, or required to be installed in conduit per the NEC with no other conductors shall be bare tinned copper. Bare conductors installed in metallic conduits shall be bonded to the metallic conduit at both ends.
- D. Grounding electrode conductors routed between concealed grounding electrodes or interconnecting grounding electrode counterpoise loop conductors to exposed (IE "Pigtails") shall be bare tinned copper.

2.03 GROUNDING ELECTRODES

- A. Ground rods shall be 3/4-inch by 10-foot copper clad steel or stainless steel and constructed in accordance with UL 467. The minimum copper thickness on copper clad ground rods shall be 10 mils.
- B. Manufacturers for ground rods
 - 1. ERICO
 - 2. Copperweld
 - 3. Blackburn Grounding
 - 4. Thomas & Betts
 - 5. Approved equal.

2.04 CONNECTORS AND CONNECTIONS

- A. Waterpipe ground clamps shall be 316 stainless steel. Provide the correct size for the pipe.
 - 1. Manufacturers
 - a. Thomas & Betts Co. Cat. JPT
 - b. Burndy
 - c. O.Z. Gedney Co.
 - d. Cooper Power Systems

- e. Erico
- f. Harger
- g. Approved equal.
- B. Other grounding system clamps, where specified or shown shall be 316 stainless steel.
 - 1. Manufacturers
 - a. Thomas & Betts Co.
 - b. Burndy
 - c. O.Z. Gedney Co.
 - d. Cooper Power Systems
 - e. Erico
 - f. Harger
 - g. Approved equal.
- C. All concealed grounding system or lightning protection system connections shall be by an exothermic weld process.
 - 1. Manufacturers
 - a. T&B Furseweld SCR1
 - b. Burndy Thermoweld
 - c. Cadweld
 - d. Approved equal.
 - 2. Exothermic welded connections shall be used in exposed locations as specified herein.
- D. Provide a Burndy Hyground Irreversible Compression System or equal in areas where the Owner's operations prevent the use of an exothermic welded connection. The use of a compression system ground connection is otherwise prohibited without written approval on a case-by-case basis from the Owner or Engineer. Permission shall be submitted through the RFI process. Compression connectors installed without permission shall be removed and replaced with exothermic weld connections with no change in the Contract Price or change in the Contract Schedule allowed.
- E. All grounding connections which would require exothermic welding in a Class 1 Division 1 Area as determined by NFPA 820, or the Engineer, or the NEC Authority Having Jurisdiction shall use a Burndy Hyground Irreversible Compression System, or equal.

PART 3 EXECUTION

3.01 MATERIALS AND EQUIPMENT

A. Design. Provide grounding cable and materials with the following characteristics:

1. Use a grounding system designed in accordance with NEC Article No. 250 Grounding, and the IEEE 142-82 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

B. Materials

1. Use grounding conductors, tin plated bare or insulated, which are manufactured and tested in accordance with applicable standards ASTM B3, ASTM B8 and ASTM B33.
2. Provide a main ground loop of No. 4/0 AWG, Class C stranded, bare copper cable. Unless otherwise shown or specified, small groups of isolated equipment may be grounded by a No. 2 AWG minimum insulated conductor connected to the main loop. Unless otherwise shown or specified, generally, taps shall be sized as follows:
 - a. Main ground ring or grid #4/0 minimum
 - b. Switchgear, motor control centers and power transformers #4/0
 - c. Motors 200 hp and above #4/0
 - d. Power panels - AC and DC #2/0
 - e. Control panels and consoles #2
 - f. Building columns #4/0
 - g. Fencing posts #2/0
3. Single conductor insulated grounding conductors shall use 600-volt insulation. Use ground conductors identified with green insulation or green tape marking.
4. Supply identifying ribbon, which is PVC tape, 3 inches wide, red color, permanently imprinted with "CAUTION BURIED ELECTRIC LINE BELOW" in black letters as specified in Section 16195, Electrical Identification.
5. Utilize tin plated flexible copper braid across hinged chain link or fence gates to bond the movable portion to the grounded fence post.

3.02 CONSTRUCTION CRITERIA

A. Unless otherwise shown or specified, the following criteria shall be followed:

1. The main ground loop at a depth of at least 30 inches below earth surface. Connect the ground loop to ground rods and to tap connections to form a complete system as indicated on the electrical Drawings. The grounding of service equipment, structures and fences to comply with the NEC, local authorities and the serving utility company.
2. Electrical equipment, buildings, tanks, and other structures and equipment shall be grounded as indicated on the Drawings. Where ground rods are required, the rods shall be 10 feet long, 3/4-inch diameter, copper-clad steel ground rods. Rods shall be driven vertically, and the top of the rods shall be a minimum of 18 inches

below finished grade, or as specified on the Drawings. Provide ground wells per the drawings.

3. Local pushbutton and selector switch stations, two-wire control devices, disconnect switches, lighting transformers, panelboards, operator panels, benchboards, and the enclosures of other electrical apparatus shall be grounded through the equipment grounding conductors run with the power supply or control circuit conductors, or shall be grounded as shown on the Drawings.
4. Ground medium voltage motors, in addition to the grounding conductors in the motor feeder cable, with a separate No. 4/0 AWG cable to motor frame.
5. Motors having power supplied by multiconductor cable shall be grounded by a separate grounding conductor in the cable and where supplied by single conductor cable in conduit by a grounding conductor pulled in the conduit. Connect ground conductors to the ground bus in the motor control center and to the ground terminal provided in the motor conduit box.
6. Do not ground the insulated bearing pedestals of large motors.
7. Connect ladder-type cable trays to the grounding electrode system.
8. Install a warning ribbon approximately 12 inches below finished grade directly above the ground grid.
9. Connect fence posts of chain link and metal fences to the main ground loop at least every 50 feet. Install bonding straps to gates.

3.03 INSTALLATION

- A. Route exposed grounding electrode conductors in rigid metallic conduits to protect the conductors from damage. The rigid metallic conduits shall be aluminum or PVC-coated aluminum conduits as specified in 16110. Bond the protecting conduits to the grounding electrode conductors at both ends. Water pipe grounding connections shall not be painted. Painted connections shall be disassembled, replaced, and reconnected.
- B. Install equipment grounding conductors in all raceways for the power, control, and instrumentation systems. Grounding conductors shall be independent conductors and shall be separate from all shield drain wires.
- C. Conduits and other raceways shall contain an equipment grounding conductor whether the raceway is metallic or not. Conduits, motors, cabinets, outlets, and other equipment shall be properly bonded in accordance with NEC requirements. Where ground wire is exposed to mechanical damage, install wire in rigid metallic conduit.
- D. In NEC classified areas, the connections between grounding electrodes and structural steel columns shall be made with long barrel type one-hole heavy duty copper compression lugs, bolted through 1/2-inch maximum diameter holes drilled in the column web, with stainless steel hex head cap screws and nuts.
- E. In new construction, bond each building column to the grounding electrode counterpoise system whether or not specifically shown on the Drawings using

grounding electrode conductors. Grounding electrode conductors rising from the counterpoise to bond to a column shall be made using an insulated conductor the same size as the conductors used to form the counterpoise. Exposed grounding electrode conductors shall be routed in rigid aluminum PVC-coated aluminum conduit. Bond metallic conduits as specified. Grounding electrode conductor connections to structural steel columns shall be made with as permitted by the Structural Engineer with long barrel type one-hole heavy duty copper compression lugs, bolted through 1/2-inch maximum diameter holes drilled in the column web, with stainless steel hex head cap screws and nuts. Exothermic welds are acceptable in non-classified areas if approved by the Structural Engineer.

- F. Metal conduits stubbed into a motor control center shall be terminated with insulated grounding bushings and connected to the motor control center ground bus. Bond boxes mounted below motor control centers to the motor control center ground bus. Size the grounding wire in accordance with NEC Table 250.122, except that a minimum #12 AWG shall be used.
- G. Liquid tight flexible metal conduit in sizes 1-1/2-inch and larger shall have bonding jumpers. Bonding jumpers shall be external, run parallel (not spiraled) and fastened with plastic tie wraps.
- H. Ground transformer neutrals to the nearest available grounding electrode with a conductor sized as shown with a minimum size in accordance with NEC Article 250.66.
- I. Provide power system grounding electrodes (ground rods) no closer than twice the length of the ground rod. Where a lightning protection is specified to be provided, provide a dedicated lightning protection system grounding electrode (ground rod) at the end of every down lead if no counterpoise is present, or connect directly to the power system counterpoise without driving a separate ground rod.
- J. Provide a #1/0 AWG bare tinned grounding conductor the full length of each cable tray system, bond each section and tray fitting to the tray grounding conductor. Route the tray grounding conductor along the outside of the cable tray. Install no grounding clamps on the inside of the tray to avoid damage to tray conductors. Bond the tray grounding conductor to the power system counterpoise grounding electrode system at the end of the tray, or for tray systems installed in a loop configuration, bond in at least two locations at opposite sides of the tray loop. Bond every enclosure to which tray conductors are routed to the tray grounding conductor. Bond every conduit or raceway routing tray conductors away from or to the tray system to the cable tray and to the cable tray grounding conductor.
- K. All equipment enclosures, motor and transformer frames, conduits systems, cable tray, cable armor, exposed structural steel and all other equipment and materials required by the NEC to be grounded, shall be grounded, and bonded in accordance with the NEC.
- L. Seal exposed connections between different metals with no-oxide paint, Grade A or equal.

- M. Lay all underground grounding conductors' slack and, where exposed to mechanical injury, protect by pipes or other substantial guards. If guards are iron pipe, or other magnetic material, electrically connect conductors to both ends of the guard. Make connections as specified herein.
- N. Care shall be taken to ensure good ground continuity, between the conduit system and equipment frames and enclosures. Where necessary, bonding jumper conductors shall be provided.
- O. Ground all grounding type receptacles to the outlet boxes with a minimum, #12 AWG XHHW-2 stranded green conductor, connected to the ground terminal of the receptacle, and bonded to the outlet box by means of a grounding screw.
- P. Equipment Grounding. As a minimum unless otherwise shown or specified, the following shall be provided:
 - 1. Make grounding connections to surfaces which are dry and cleaned of paint, rust, oxides, scales, grease, and dirt to ensure good conductivity. Clean copper and galvanized steel to remove oxide before making welds or connections.
 - 2. Use the exothermic welding process for below-grade grounding connections. Use mechanical connectors or thermal connections for above-grade grounding connections as shown on the Drawings.
 - 3. Make grounding connections to electrical equipment, vessels, mechanical equipment, and ground rods in accordance with the Drawings.
 - 4. Ground tanks and vessels by making connections to integral structural supports or to existing grounding lugs or pads, and not to the body of the tank or vessel. Tanks which have cathodic protection shall not be grounded unless such grounding is approved by a NACE certified engineer.
 - 5. Leave ground connections to equipment visible for inspection. Protect them with PVC non-metallic conduit as indicated on the Drawings.
 - 6. Make connections to motor frames and ground buses with lugs attached to the equipment by means of bolts. Do not use motor anchor bolts or equipment housing for fastening lugs of grounding cable.
 - 7. Where the wiring for lighting systems consists of single conductor cables in conduit, provide each conduit with an equipment grounding conductor. Use a grounding conductor with green colored insulation and ground equipment in the lighting system.
- Q. Raceway and Support Systems Grounding. As a minimum unless otherwise shown or specified, the following shall be provided:
 - 1. Install raceway, cable rack or tray and conduit so that it is bonded together and permanently grounded to the equipment ground bus, according to the Drawings. Connection to conduit may be grounding bushing or ground clamp.
 - 2. Install raceway at low voltage motor control centers or other low voltage control equipment so that it is bonded and grounded, except that any conduit which is

effectively grounded to the sheet metal enclosure by bonding bushing or hubs need not be otherwise bonded.

3. Where a grounding conductor is run in or on a cable tray, bonds the grounding conductor to each section of cable tray with a cable tray ground clamp.
 4. Where only grounding conductor is installed in a metal conduit, bond both ends of the conduit to the grounding conductor.
 5. Provide flexible "jumpers" around raceway expansion joints. Use copper bonding straps for steel conduit. Install jumpers across cable tray joints which have been parted to allow for expansion and any hinged cable tray connections.
 6. Fences and Gates. Ground fences, fence posts and gates to the underground grid as shown on the Drawings.
- R. Power System Grounding. As a minimum unless otherwise shown or specified, the following shall be provided:
1. Solidly ground the secondary neutral of the main power supply transformer either to the ground grid or through an impedance. See Drawings for details.
 2. Solidly ground the neutral of lighting, instrument, and control transformers.
- S. Cable Armor and Shields. As a minimum unless otherwise shown or specified, the following shall be provided:
1. For shielded control cable, terminate and ground the shield at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables. Maintain shield continuity by jumping the ground shield across connection point where it is broken at junction boxes, or other splice points. Insulate these points from ground.
 2. Connect the ground wire in power cable assemblies at each terminal point to a ground bus, if available, or to the equipment enclosure. Do not carry these ground wires through a "doughnut" current transformer (CT) used for ground fault relaying; do carry ground leads from stress cones through CTs. Ground power cable armor and shield at each terminal point.
- T. Test Wells. As a minimum unless otherwise shown or specified, the following shall be provided:
1. Provide access (test wells) for testing the ground grid system at one or several ground rod locations. Make test wells of a concrete body surrounding the rod and connections with a cast iron cover placed on top at grade level indicated as GROUND. rod and connections with a cast iron cover placed on top at grade level indicated as ground. The ground rod well shall be a minimum 12" in diameter and 12" in length reinforced concrete provided by National Lightning Protection or equal. See Drawings for details.
 2. Install a test well at the service entrance pole to serve as the service entrance grounding electrode.

3.04 INSPECTION AND TESTING

- A. Inspect the grounding and bonding system conductors and connections for tightness and proper installation.
- B. Use Biddle Direct Reading Earth Resistance Tester or equivalent test instrument to measure resistance earth resistivity at each structure having a counterpoise grounding system or a lightning protection system. Measure the earth-to-ground of each system having a counterpoise grounding system or a lightning protection system installed. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.
- C. All test equipment shall be provided under this Section and approved by the Owner/Engineer.
- D. Resistance to ground testing shall be preceded by no precipitation for a minimum of five days. Submit test results in the form of a graph showing the number of points measured (12 minimum) and the numerical resistance to ground.
- E. Testing shall be performed before energizing the electrical distribution system.
- F. A separate test shall be conducted for each building or system.
- G. Notify the Engineer immediately if the resistance to ground for any building or system is greater than five ohms.
- H. Perform soil resistivity measurements prior to the installation of any grounding systems and submit the results to the Engineer.
- I. Perform ground resistance tests after underground installation and connections to building steel are complete, unless otherwise noted on applicable Drawings.
- J. Make tests at each ground test well using a "fall of potential" test method. Each ground test well shall not exceed a maximum resistance of 5 ohms. Where measured values exceed this figure, install additional ground rods as required to reduce the resistance to the specified limit.
- K. Submit the results of the ground-to-earth tests to the Owner and the Engineer.

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SECTION 16661

STANDBY NATURAL GAS ENGINE GENERATOR

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Specification for standby natural gas engine generator in an outdoor sound attenuated weatherproof enclosure.

1.2 REFERENCES

- A. NFPA 37 – Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
- B. NFPA 70 – National Electrical Code.
- C. NFPA 110 – Standard for Emergency and Standby Power Systems.
- D. UL 1236 – Battery Chargers for Charging Engine-Starter Batteries
- E. UL 2200 – Standard for Stationary Engine Generator Assemblies.

1.3 SUBMITTALS

- A. The submittal shall include Standby Natural Gas Engine Generator, Sound Attenuating Enclosure, and other peripherals required for a complete system. Incomplete submittals or separate submittals for each of these components are not acceptable and will be returned without review.
- B. Submit the following under the provisions of Section 01350 – Submittals:
 - 1. Product Data:
 - a. Rated capacities, operating characteristics, and furnished specialties and accessories.
 - b. Load summary and motor starting/step load analysis for generator.
 - c. Thermal damage curve for generator.
 - d. Time-current characteristic curves for generator protective device.
 - e. Sound test data based on a free field requirement.
 - 2. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.
 - a. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - b. Wiring Diagrams: System schematics (power and controls), customer connections
 - c. Fabrication/Erection/Installation drawings
 - d. Structural support drawings including rigging requirements, foundation and structural support requirements, operating and rigging weights, support point loading data.

3. Certifications:
 - a. Submit statement of compliance which states the proposed product(s) is certified to the emissions standards required by the location for EPA, stationary emergency application.
4. Source quality control test reports:
 - a. Certified summary of prototype-unit test report. See requirements in Part 2 "Source Quality Control" Article Part A. Include statement indicating torsional compatibility of components.
 - b. Certified Test Report: Provide certified test report documenting factory test per the requirements of this specification, as well as certified factory test of generator set sensors per NFPA110 level 1.
 - c. List of factory tests to be performed on units to be shipped for this Project.
 - d. Report of exhaust emissions and compliance statement certifying compliance with applicable regulations.
5. Warranty:
 - a. Submit manufacturer's warranty statement to be provided for this Project.
6. Operation and Maintenance Manuals: Provide three (3) hard copies in 3-ring binders and one (1) electronic copy on USB flash drive of Operation and Maintenance manuals, in accordance with Section 01350, with the following:
 - a. Recommended spare parts list
 - b. Factory test reports
 - c. Drawings
 - 1) As-built schematics
 - d. As-built wiring diagrams
 - e. Components data sheets
 - f. Maintenance recommendations

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 50 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Comply with NFPA 37 (Standard For the Installation and Use of Stationary Combustion Engines and Gas Turbines).
- E. Comply with NFPA 70 (National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702).

- F. Comply with NFPA 110 (Emergency and Standby Power Systems) requirements for Level 1 emergency power supply system.
 - G. Comply with UL 2200.
- 1.5 PROJECT CONDITIONS
- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: 0.0 deg C (32.0 deg F) to 40.0 deg C (104.0 deg F)
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1800.0 feet (549.0 m).
- 1.6 WARRANTY
- A. Base Warranty: Manufacturer shall provide base warranty coverage on the material and workmanship of the generator set, including all components and appurtenances, for a minimum of twenty-four (24) months from registered commissioning and start-up.
 - B. Extended Warranty: Manufacturer shall offer extend coverage of 5 years from date of registered commissioning and start-up.
- 1.7 MAINTENANCE PLAN
- A. Provide a minimum three (3) year maintenance plan that includes annual, semi-annual, and quarterly checks of the below items:
 - 1. Annual maintenance to change oil and filters.
 - 2. While engine is not running, check the electrical system, oil and coolant levels, and for leaks, holes and connections.
 - 3. Semi-annual check of the battery and charger to clean any corrosion, record load, acid and specific gravity, and adjust charger output as necessary.
 - 4. Check fuel system for leaks, water and sediment. Also check the governor linkage and float switch pump.
 - 5. Check coolant system; to include antifreeze, radiator and cap leaks, hoses, belts and tension.
 - 6. Check the intake and exhaust for air cleaner, turbocharger, muffler and traps, leaks and breather, flex pipe, and rain cap.
 - 7. Check generator diodes, end bearing, brushes, folder, A.C. wiring, exciter stator, overspeed switch and breakers.
 - 8. Check voltage regulator, wiring relays, monitors and bulbs.
 - 9. Check transfer switch time delays, exerciser clocks, and clean cabinet.
 - 10. While engine is running, record A.C. output, frequency, and amps under load.

- B. Scheduled checks to be provided for the following items:
 - 1. Cooling system; to include radiator air restriction, hoses, connection, fluid concentration, and belt and louver operation.
 - 2. Air intake system; to include checking for leaks, holes, and loose connections.
 - 3. Fuel system; to include fuel levels and pump.
 - 4. Exhaust system; to include checking for leaks, restrictions and flush condensation cap.
 - 5. Electrical system; to include reviewing meters and battery fluid and recharging if needed.
- C. Maintenance to be performed by certified technicians from generator manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Natural Gas Driven Generating Set, complete with accessories, shall be manufactured by the following:
 - 1. Kohler
 - 2. Caterpillar
 - 3. No Approved Equal

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 - 1. Rigging Information: Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings.
- C. Capacities and Characteristics:
 - 1. Power Output Ratings: Electrical output power rating for Standby operation as noted on Drawings, at 80 percent lagging power factor, 277/480, Series Wye, Three phase, 4 -wire, 60 hertz.
 - 2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component. The engine-generator nameplate shall include information of the power output rating of the equipment.
- D. Generator-Set Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 1.0 percent of rated output voltage from no load to full load.
 - 2. Transient Voltage Performance: Not more than 15 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the

steady-state operating band within 2 seconds. On application of a 100% load step the generator set shall recover to stable voltage within 10 seconds.

3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Not more than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 2 seconds. On application of a 100% load step the generator set shall recover to stable frequency within 10 seconds.
6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for any single harmonic. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 8 seconds without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.
8. Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements.
9. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.

2.3 ENGINE

- A. Fuel: Natural Gas
- B. Rated Engine Speed: 1800RPM.
- C. Lubrication System: The following items are mounted on engine or skid:
 1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
 2. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer's instructions

- E. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and performance.
 - 1. Designed for operation on a single 240 VAC, Single phase, 60Hz power connection. Heater voltage shall be shown on the project drawings.
 - 2. Installed with isolation valves to isolate the heater for replacement of the element without draining the engine cooling system or significant coolant loss.
 - 3. Provided with a 24VDC thermostat, installed at the engine thermostat housing
- F. Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.
- G. Cooling System: Closed loop, liquid cooled
 - 1. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 40 deg C.
 - 2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 - 3. Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 - 4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 - 5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 - 6. Duct Flange: Generator sets installed indoors shall be provided with a flexible radiator duct adapter flange.
- H. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. For generator sets with outdoor enclosures the silencer shall be inside the enclosure.
- I. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.

- J. Starting System: 12 or 24V, as recommended by the engine manufacturer; electric, with negative ground.
- 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
- 2. Cranking Cycle: As required by NFPA 110 for level 1 systems.
- 3. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.
- 4. Battery Compartment: Factory fabricated of metal with acid-resistant finish.
- 5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.
- 6. Battery Chargers: Unit shall comply with UL 1236, provide fully regulated, constant voltage, current limited, battery charger for each battery bank. It will include the following features:
 - a. Operation: Equalizing-charging rate based on generator set manufacturer's recommendations shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 20 deg C to plus 40 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - e. Provide LED indication of general charger condition, including charging, faults, and modes. Provide a LCD display to indicate charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.
 - f. Enclosure and Mounting: NEMA, Type 1, wall-mounted cabinet.

2.4 CONTROL AND MONITORING

- A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.

- B. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- D. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.
- E. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
 - 1. AC voltmeter (3-phase, line to line and line to neutral values).
 - 2. AC ammeter (3-phases).
 - 3. AC frequency meter.
 - 4. AC kVA output (total and for each phase). Display shall indicate power flow direction.
 - 5. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
 - 6. Emergency Stop Switch: Switch shall be a red “mushroom head” pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
 - 7. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
 - 8. DC voltmeter (alternator battery charging).
 - 9. Engine-coolant temperature gage.
 - 10. Engine lubricating-oil pressure gage.
 - 11. Running-time meter.

12. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjustment of these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.)
13. AC Protective Equipment: The control system shall include over/under voltage, over current, short circuit, loss of voltage reference, and over excitation shut down protection. There shall be an overload warning, and overcurrent warning alarm.
14. Status LED indicating lamps to indicate remote start signal present at the control, existing alarm condition, not in auto, and generator set running.
15. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.
16. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.
17. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).
- F. Remote Alarm Annunciator: Comply with NFPA 110. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition.
- G. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.5 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Overcurrent Protection: The generator set shall be provided with a UL Listed/CSA Certified protective device that is coordinated with the alternator provided to prevent damage to the generator set on any possible overload or overcurrent condition external to the machine. The protective device shall be listed as a utility grade protective device under UL category NRGU. The control system shall be subject to UL follow-up service at the manufacturing location to verify that the protective system is fully operational as manufactured. Protector shall perform the following functions:
 1. Initiates a generator kW overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 2. Under single phase or multiple phase fault conditions, or on overload conditions, indicates an alarm conditions when the current flow is in excess of 110% of rated current for more than 10 seconds.

3. Under single phase or multiple phase fault conditions, operates to switch off alternator excitation at the appropriate time to prevent damage to the alternator.
4. The operator panel shall indicate the nature of the fault condition as either a short circuit or an overload.
5. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot greater than 120% of nominal voltage.
6. The protective system provided shall not include an instantaneous trip function.
- B. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H
- D. Temperature Rise: 125 / Class H environment.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance.
- G. Enclosure: Drip-proof.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, 3-phase true RMS sensing, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.
- I. The alternator shall be provided with anti-condensation heater(s) in all applications where the generator set is provided in an outdoor enclosure, or when the generator set is installed in a coastal or tropical environment.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12 percent maximum, based on the rating of the engine generator set.

2.7 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Sound Attenuated Steel housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure.
- B. Construction:

1. Louvers: Equipped with bird screen to permit air circulation when engine is not running while excluding birds and rodents.
2. Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to prevent door to keep door open at 180 degrees during maintenance. Rain lips over all doors.
3. Exhaust System:
 - a. Muffler Location: Within enclosure.
4. Hardware: All hardware and hinges shall be stainless steel.
5. Mounting Base: Suitable for mounting on sub-base fuel tank or housekeeping pad.
6. A weather protective enclosure shall be provided which allows the generator set to operate at full rated load with a static pressure drop equal to or less than 0.5 inches of water.
7. Inlet ducts shall include rain hoods
- C. Engine Cooling Airflow through Enclosure: Housing shall provide ample airflow for engine generator operation at rated load in an ambient temperature of 40 deg C.
- D. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 65 dBA measured at any location 10 ft from the engine generator in a free field environment.
- E. Site Provisions:
 1. Lifting: Complete assembly of engine generator, enclosure shall be designed to be lifted into place as a single unit, using spreader bars.

2.8 VIBRATION ISOLATION DEVICES

- A. Vibration Isolation: Generators installed on concrete platform shall be provided with elastomeric isolator pads integral to the generator, unless the engine manufacturer requires use of spring isolation.

2.9 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Powder-coated and baked over corrosion-resistant pretreatment and compatible primer. Manufacturer's standard color or as directed on the drawings.

2.10 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 1. Tests: Comply with NFPA 110, Level 1 Energy Converters. In addition, the equipment engine, skid, cooling system, and alternator shall have been subjected

to actual prototype tests to validate the capability of the design under the abnormal conditions noted in NFPA110. Calculations and testing on similar equipment which are allowed under NFPA110 are not sufficient to meet this requirement.

- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test engine generator set manufactured for this Project to demonstrate compatibility and functionality.
 - 2. Full load run.
 - 3. Maximum power.
 - 4. Voltage regulation.
 - 5. Steady-state governing.
 - 6. Single-step load pickup.
 - 7. Simulated safety shutdowns.
 - 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION PREPARATION

- A. Verify dimensions and ratings of equipment and materials to ensure proper fit and performance.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation, application, and alignment instructions and with NFPA 110.
- B. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- C. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
- D. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's.

- E. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.
- F. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.
- G. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

3.3 ON-SITE ACCEPTANCE TEST

- A. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. O & M Manual shall be furnished prior to testing for reference during testing and corrections for final O & M. The generator set manufacturer shall provide a site test specification covering the entire system. Tests shall include:
 - 1. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.
 - 2. Installation acceptance tests to be conducted on site shall include a "cold start" test, a crank cycle test, a two hour full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.
 - 3. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

3.4 TRAINING

- A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

3.6 SERVICE AND SUPPORT

- A. The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year. The inventory shall have a commercial value of \$3 million or more. The manufacturer of the generator set shall maintain a central parts inventory to support the supplier, covering all the major components of the power system, including engines, alternators, control systems, paralleling electronics, and power transfer equipment.
- B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be physically located within 50 miles of the site.
- C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

END OF SECTION