City of San Diego

CONTRACTOR'S NAME: Southern Contracting Company
ADDRESS: 559 North Twin Oaks Valley Road, San Marcos, California 92069
TELEPHONE NO.: 7607440760 **Email .:** pwaterman@southerncontracting.com
CITY CONTACT: Ron McMinn, Contract Specialist, Email: rmcminn@sandiego.gov
Phone No. (619) 533-4618
G. Torres / A. Jaro / R. Sigston

BIDDING DOCUMENTS

e - Bidding

FINAL

FOR

MBC GAS DETECTION SYSTEM REPLACEMENT

BID NO.: **K-23-2127-DBB-3**
SAP NO. (WBS/IO/CC): **B-20121**
CLIENT DEPARTMENT: **2000**
COUNCIL DISTRICT: **6**
PROJECT TYPE: **BO**

THIS CONTRACT WILL BE SUBJECT TO THE FOLLOWING:

- THE CITY'S SUBCONTRACTING PARTICIPATION REQUIREMENTS FOR SLBE PROGRAM
- PREVAILING WAGE RATES: STATE ☒ FEDERAL ☐
- APPRENTICESHIP

THIS CONTRACT MAY BE SUBJECT TO THE FOLLOWING:

- PHASED-FUNDING

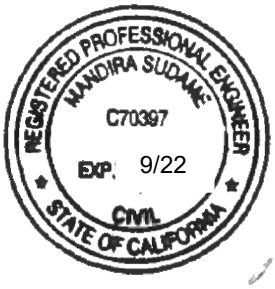
BID DUE DATE:

2:00 PM
April 25, 2023
CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

http://www.sandiego.gov/cip/bidopps/index.shtml

ENGINEER OF WORK

The engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineers:



1) Registered Engineer — 3/21/2023 — Date — Seal:

Mandira Sudame

R.C.E. C-70397

2) For City Engineer — 3/17/2023 — Date — Seal:

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REQUIRED DOCUMENTS SCHEDULE DURING BIDDING AND AWARDING

The Bidder's attention is directed to the City's Municipal Code §22.0807(e), (3)-(5) for important information regarding grounds for debarment for failure to submit required documentation.

The specified Equal Opportunity Contracting Program (EOCP) forms are available for download from the City's web site at:

http://www.sandiego.gov/eoc/forms/index.shtml

ITEM	DOCUMENT TO BE SUBMITTED	WHEN DUE	FROM
1.	Bid Bond (PDF via PlanetBids)	At Time of Bid	ALL BIDDERS
2.	Contractors Certification of Pending Actions	At Time of Bid	ALL BIDDERS
3.	Mandatory Disclosure of Business Interests	At Time of Bid	ALL BIDDERS
4.	Debarment and Suspension Certification for Prime Contractors	At Time of Bid	ALL BIDDERS
5.	Debarment and Suspension Certification for Subcontractors, Suppliers & Mfgrs	At Time of Bid	ALL BIDDERS
6.	Bid Bond (Original)	By 5PM 1 working day after bid opening	ALL BIDDERS
7.	SLBE Good Faith Effort Documentation	By 5 PM 3 working days after bid opening	ALL BIDDERS
8.	Form AA60 – List of Work Made Available	By 5 PM 3 working days after bid opening with Good Faith Effort (GFE) documentation	ALL BIDDERS
9.	Phased Funding Schedule Agreement	Within 10 working days of the Notice of Intent to Award	AWARDED BIDDER
10.	If the Contractor is a Joint Venture: • Joint Venture Agreement • Joint Venture License	Within 10 working days of receipt by bidder of contract forms	AWARDED BIDDER
11.	Payment & Performance Bond: Certificates of Insurance & Endorsements	Within 10 working days of receipt by bidder of contract forms and NOI	AWARDED BIDDER

ITEM	DOCUMENT TO BE SUBMITTED	WHEN DUE	FROM
12.	Signed Contract Agreement Page	Within 3 working days of receipt by bidder of Contract Agreement	AWARDED BIDDER
13.	Listing of "Other Than First Tier" Subcontractors	Within 10 working days of receipt by bidder of contract forms	AWARDED BIDDER

NOTICE INVITING BIDS

1. **SUMMARY OF WORK:** This is the City of San Diego's (City) solicitation process to acquire Construction services for **MBC Gas Detection System Replacement.** For additional information refer to Attachment A.

2. **FULL AND OPEN COMPETITION:** This solicitation is subject to full and open competition and may be bid by Contractors on the City's approved Prequalified Contractors List. For information regarding the Contractors Prequalified list visit the City's web site: http://www.sandiego.gov.

3. **ESTIMATED CONSTRUCTION COST:** The City's estimated construction cost for this project is **$5,220,000**.

4. **BID DUE DATE AND TIME ARE: APRIL 25, 2023** at **2:00 PM**.

5. **PREVAILING WAGE RATES APPLY TO THIS CONTRACT:** Refer to Attachment D.

6. **LICENSE REQUIREMENT**: To be eligible for award of this contract, Prime contractor must possess the following licensing classification: **A or C-10**

7. **SUBCONTRACTING PARTICIPATION PERCENTAGES**: Subcontracting participation percentages apply to this contract.

7.1. The City has incorporated **mandatory** SLBE-ELBE subcontractor participation percentages to enhance competition and maximize subcontracting opportunities. For the purpose of achieving the mandatory subcontractor participation percentages, a recommended breakdown of the SLBE and ELBE subcontractor participation percentages based upon certified SLBE and ELBE firms has also been provided to achieve the mandatory subcontractor participation percentages:

1. SLBE participation **2.5%**
2. ELBE participation **3.9%**
3. Total mandatory participation **6.4%**

7.2. The Bid may be declared non-responsive if the Bidder fails to meet the following requirements:

7.2.1. Include SLBE-ELBE certified subcontractors at the overall mandatory participation percentage identified in this document; OR

7.2.2. Submit Good Faith Effort (GFE) documentation, saved in searchable Portable Document Format (PDF), demonstrating the Bidder made a good faith effort to conduct outreach to and include SLBE-ELBE Subcontractors as required in this solicitation by 5 PM 3 Working Days after the Bid opening if the overall mandatory participation percentage is not met.

All submittals in searchable PDF shall be submitted electronically within the prescribed time identified in the contract documents via PlanetBids by invitation to the point of contact named in the bid provided by the Contract Specialist to all bidders.

8. PRE-BID SITE VISIT: All those wishing to submit a bid are encouraged to visit the Work Site with the Engineer. The purpose of the Site visit is to acquaint Bidders with the Site conditions. To request a sign language or oral interpreter for this visit, call the Purchasing & Contracting Department, Public Works Division at (619) 533-3450 at least 5 Working Days prior to the meeting to ensure availability. The Pre-Bid Site Visit is scheduled as follows:

Time: 8:30 AM to 11:00 AM
Date: APRIL 10, 2023
Location: 5240 CONVOY STREET, SAN DIEGO CA 92111

9. AWARD PROCESS:

9.1. The Award of this contract is contingent upon the Contractor's compliance with all conditions of Award as stated within these documents and within the Notice of Intent to Award.

9.2. Upon acceptance of bids and determination of the apparent low bidder, the City will prepare the contract documents for execution within approximately 21 days of the date of the bid opening. The City will then award the contract upon receipt of properly signed Contract, bonds, and insurance documents.

9.3. This contract will be deemed executed and effective only upon the signing of the Contract by the Mayor or his designee and approval as to form by the City Attorney's Office.

9.4. The low Bid will be determined by the Base Bid.

9.5. Once the low bid has been determined, the City may, at its sole discretion, award the contract for the Base Bid alone.

10. SUBMISSION OF QUESTIONS:

10.1. The Director (or Designee) of the Purchasing & Contracting Department is the officer responsible for opening, examining, and evaluating the competitive Bids submitted to the City for the acquisition, construction and completion of any public improvement except when otherwise set forth in these documents. Any questions related to this solicitation shall be submitted to:

RMcMinn@sandiego.gov

10.2. Questions received less than 14 days prior to the date for opening of Bids may not be considered.

10.3. Questions or clarifications deemed by the City to be material shall be answered via issuance of an addendum and posted to the City's online bidding service.

10.4. Only questions answered by formal written addenda shall be binding. Oral and other interpretations or clarifications shall be without legal effect. It is the Bidder's responsibility to be informed of any addenda that have been issued and to include all such information in its Bid.

11. PHASED FUNDING: This contract may be subject to phased funding, for Conditions, see Attachment B.

1. PREQUALIFICATION OF CONTRACTORS:

1.1. Contractors submitting a Bid must be pre-qualified for the total amount proposed, including all alternate items, prior to the date of submittal. Bids from contractors who have not been pre-qualified as applicable and Bids that exceed the maximum dollar amount at which contractors are pre-qualified may be deemed **non-responsive** and ineligible for award.

1.2. The completed application must be submitted online no later than 2 weeks prior to the bid opening.

1.3. **Joint Venture Bidders Cumulative Maximum Bidding Capacity:** For projects with an engineer's estimate of $30,000,000 or greater, Joint Ventures submitting bids may be deemed responsive and eligible for award if the cumulative maximum bidding capacity of the individual Joint Venture entities is equal to or greater than the total amount proposed.

1.3.1. Each of the entities of the Joint Venture must have been previously prequalified at a minimum of $15,000,000.

1.3.2. Bids submitted with a total amount proposed of less than $30,000,000 are not eligible for Cumulative Maximum Bidding Capacity prequalification. To be eligible for award in this scenario, the Joint Venture itself or at least one of the Joint Venture entities must have been prequalified for the total amount proposed.

1.3.3. Bids submitted by Joint Ventures with a total amount proposed of $30,000,000 or greater on a project with an engineer's estimate of less than $30,000,000 are not eligible for Cumulative Maximum Bidding Capacity prequalification.

1.3.4. The Joint Venture designated as the Apparent Low Bidder shall provide evidence of its corporate existence and furnish good and approved bonds in the name of the Joint Venture within 14 Calendar Days of receipt by the Bidder of a form of contract for execution.

1.4. Complete information and links to the on-line prequalification application are available at:

http://www.sandiego.gov/cip/bidopps/prequalification

1.5. Due to the City's responsibility to protect the confidentiality of the contractors' information, City staff will not be able to provide information regarding contractors' prequalification status over the telephone. Contractors may access real-time information about their prequalification status via their vendor profile on PlanetBids.™

2. **ELECTRONIC FORMAT RECEIPT AND OPENING OF BIDS:** Bids will be received in electronic format (eBids) EXCLUSIVELY at the City of San Diego's electronic bidding (eBidding) site, at: http://www.sandiego.gov/cip/bidopps/index.shtml and are due by the date, and time shown on the cover of this solicitation.

2.1. **BIDDERS MUST BE PRE-REGISTERED** with the City's bidding system and possess a system-assigned Digital ID in order to submit and electronic bid.

2.2. The City's bidding system will automatically track information submitted to the site including IP addresses, browsers being used and the URLs from which information was submitted. In addition, the City's bidding system will keep a history of every login instance including the time of login, and other information about the user's computer configuration such as the operating system, browser type, version, and more. Because of these security features, Contractors who disable their browsers' cookies will not be able to log in and use the City's bidding system.

2.3. The City's electronic bidding system is responsible for bid tabulations. Upon the bidder's or proposer's entry of their bid, the system will ensure that all required fields are entered. **The system will not accept a bid for which any required information is missing.** This includes all necessary pricing, subcontractor listing(s) and any other essential documentation and supporting materials and forms requested or contained in these solicitation documents.

2.4. **BIDS REMAIN SEALED UNTIL BID DEADLINE.** eBids are transmitted into the City's bidding system via hypertext transfer protocol secure (https) mechanism using SSL 128-256 bit security certificates issued from Verisign/Thawte which encrypts data being transferred from client to server. Bids submitted prior to the "Bid Due Date and Time" are not available for review by anyone other than the submitter who has until the "Bid Due Date and Time" to change, rescind or retrieve its proposal should it desire to do so.

2.5. **BIDS MUST BE SUBMITTED BY BID DUE DATE AND TIME**. Once the bid deadline is reached, no further submissions are accepted into the system. Once the Bid Due Date and Time has lapsed, bidders, proposers, the general public, and City staff are able to immediately see the results on line. City staff may then begin reviewing the submissions for responsiveness, EOCP compliance and other issues. The City may require any Bidder to furnish statement of experience, financial responsibility, technical ability, equipment, and references.

2.6. **RECAPITULATION OF THE WORK**. Bids shall not contain any recapitulation of the Work. Conditional Bids may be rejected as being non-responsive. Alternative proposals will not be considered unless called for.

2.7. **BIDS MAY BE WITHDRAWN** by the Bidder only up to the bid due date and time.

2.7.1. Important Note: Submission of the electronic bid into the system may not be instantaneous. Due to the speed and capabilities of the user's internet service provider (ISP), bandwidth, computer hardware and other variables, it may take time for the bidder's submission to upload and be received by the City's eBidding system. It is the bidder's sole responsibility to ensure their bids are received on time by the City's eBidding system. The City of San Diego is not responsible for bids that do not arrive by the required date and time.

2.8. **ACCESSIBILITY AND AMERICANS WITH DISABILITIES ACT (ADA) COMPLIANCE:** To request a copy of this solicitation in an alternative format, contact the Purchasing & Contracting Department, Public Works Division Contract Specialist listed on the cover of this solicitation at least five (5) working days prior to the Bid/Proposal due date to ensure availability.

3. ELECTRONIC BID SUBMISSIONS CARRY FULL FORCE AND EFFECT:

3.1. The bidder, by submitting its electronic bid, acknowledges that doing so carries the same force and full legal effect as a paper submission with a longhand (wet) signature.

3.2. By submitting an electronic bid, the bidder certifies that the bidder has thoroughly examined and understands the entire Contract Documents (which consist of the plans and specifications, drawings, forms, affidavits and the solicitation documents), and that by submitting the eBid as its bid proposal, the bidder acknowledges, agrees to and is bound by the entire Contract Documents, including any addenda issued thereto, and incorporated by reference in the Contract Documents.

3.3. The Bidder, by submitting its electronic bid, agrees to and certifies under penalty of perjury under the laws of the State of California, that the certification, forms and affidavits submitted as part of this bid are true and correct.

3.4. The Bidder agrees to the construction of the project as described in Attachment "A– Scope of Work" for the City of San Diego, in accordance with the requirements set forth herein for the electronically submitted prices. The Bidder guarantees the Contract Price for a period of 120 days from the date of Bid opening. The duration of the Contract Price guarantee shall be extended by the number of days required for the City to obtain all items necessary to fulfill all conditions precedent.

4. BIDS ARE PUBLIC RECORDS: Upon receipt by the City, Bids shall become public records subject to public disclosure. It is the responsibility of the respondent to clearly identify any confidential, proprietary, trade secret or otherwise legally privileged information contained within the Bid. General references to sections of the California Public Records Act (PRA) will not suffice. If the Contractor does not provide applicable case law that clearly establishes that the requested information is exempt from the disclosure requirements of the PRA, the City

shall be free to release the information when required in accordance with the PRA, pursuant to any other applicable law, or by order of any court or government agency, and the Contractor will hold the City harmless for release of this information.

5. CONTRACTOR REGISTRATION AND ELECTRONIC REPORTING SYSTEM:

5.1. **Prior** to the Award of the Contract or Task Order, you and your Subcontractors and Suppliers must register with the City's web-based vendor registration and bid management system. For additional information go to:

http://www.sandiego.gov/purchasing/bids-contracts/vendorreg

5.2. The City may not award the contract until registration of all subcontractors and suppliers is complete. In the event this requirement is not met within the time frame specified in the Notice of Intent to Award letter, the City reserves the right to rescind the Notice of Award / Intent to Award and to make the award to the next responsive and responsible bidder / proposer.

6. JOINT VENTURE CONTRACTORS: Provide a copy of the Joint Venture agreement and the Joint Venture license to the City within 14 Calendar Days after receiving the Contract forms.

7. INSURANCE REQUIREMENTS:

7.1. All certificates of insurance and endorsements required by the contract are to be provided upon issuance of the City's Notice of Intent to Award letter.

7.2. Refer to sections 5-4, "INSURANCE" of the Supplementary Special Provisions (SSP) for the insurance requirements which must be met.

8. REFERENCE STANDARDS: Except as otherwise noted or specified, the Work shall be completed in accordance with the following standards:

Title	Edition	Document Number
Standard Specifications for Public Works Construction ("The GREENBOOK") http://www.greenbookspecs.org/	2021	ECPI010122-01
City of San Diego Standard Specifications for Public Works Construction ("The WHITEBOOK")* https://www.sandiego.gov/ecp/edocref/greenbook	2021	ECPI010122-02
City of San Diego Standard Drawings* https://www.sandiego.gov/ecp/edocref/standarddraw	2021	ECPI010122-03
Citywide Computer Aided Design and Drafting (CADD) Standards https://www.sandiego.gov/ecp/edocref/drawings	2018	PWPI010119-04
California Department of Transportation (CALTRANS) Standard Specifications https://dot.ca.gov/programs/design/ccs-standard-plans-and-standard-specifications	2018	PWPI030119-05

Title	Edition	Document Number
CALTRANS Standard Plans https://dot.ca.gov/programs/design/ccs-standard-plans-and-standard-specifications	2018	PWPI030119-06
California Manual on Uniform Traffic Control Devices Revision 6 (CA MUTCD Rev 6) https://dot.ca.gov/programs/safety-programs/camutcd/camutcd-files	2014	PWPI060121-10
NOTE: *Available online under Engineering Documents and References at: https://www.sandiego.gov/ecp/edocref/ ***Electronic updates to the Standard Drawings may also be found in the link above		

9. **CITY'S RESPONSES AND ADDENDA:** The City, at its discretion, may respond to any or all questions submitted in writing via the City's eBidding web site in the **form of an addendum**. No other responses to questions, oral or written shall be of any force or effect with respect to this solicitation. The changes to the Contract Documents through addenda are made effective as though originally issued with the Bid. The Bidders shall acknowledge the receipt of Addenda at the time of bid submission.

10. **CITY'S RIGHTS RESERVED:** The City reserves the right to cancel the Notice Inviting Bids at any time, and further reserves the right to reject submitted Bids, without giving any reason for such action, at its sole discretion and without liability. Costs incurred by the Bidder(s) as a result of preparing Bids under the Notice Inviting Bids shall be the sole responsibility of each bidder. The Notice Inviting Bids creates or imposes no obligation upon the City to enter a contract.

11. **CONTRACT PRICING:** This solicitation is for a Lump Sum contract with Unit Price provisions as set forth herein. The Bidder agrees to perform construction services for the City of San Diego in accordance with these contract documents for the prices listed below. The Bidder further agrees to guarantee the Contract Price for a period of 120 days from the date of Bid opening. The duration of the Contract Price guarantee may be extended, by mutual consent of the parties, by the number of days required for the City to obtain all items necessary to fulfill all contractual conditions.

12. **SUBCONTRACTOR INFORMATION:**

12.1. **LISTING OF SUBCONTRACTORS**. In accordance with the requirements provided in the "Subletting and Subcontracting Fair Practices Act" of the California Public Contract Code, the Bidder shall provide the **NAME** and **ADDRESS** of each Subcontractor who will perform work, labor, render services or who specially fabricates and installs a portion [type] of the work or improvement, in an amount in excess of 0.5% of the Contractor's total Bid. The Bidder shall also state within the description, whether the subcontractor is a **CONSTRUCTOR**, **CONSULTANT** or **SUPPLIER**. The Bidder shall state the **DIR REGISTRATION NUMBER** for all subcontractors and shall further state within the description, the **PORTION** of the work which will be performed by each subcontractor under this Contract. The Contractor shall list only one Subcontractor for each portion of the Work. The **DOLLAR VALUE** of the total Bid to be performed shall be stated for all subcontractors listed. Failure to comply with this requirement

may result in the Bid being rejected as **non-responsive** and ineligible for award. The Bidder's attention is directed to the Special Provisions – Section 3-2, "Self-Performance", which stipulates the percent of the Work to be performed with the Bidders' own forces. The Bidder shall list all SLBE, ELBE, DBE, DVBE, MBE, WBE, OBE, SDB, WoSB, HUBZone, and SDVOSB Subcontractors for which Bidders are seeking recognition towards achieving any mandatory, voluntary (or both) subcontracting participation goals.

Additionally, pursuant to California Senate Bill 96 and in accordance with the requirements of Labor Code sections 1771.1 and 1725.5, by submitting a bid or proposal to the City, Contractor is certifying that he or she has verified that all subcontractors used on this public work project are registered with the California Department of Industrial Relations (DIR). **The Bidder shall provide the name, address, license number, DIR registration number of any Subcontractor – regardless of tier** - who will perform work, labor, render services or specially fabricate and install a portion [type] of the work or improvement pursuant to the contract.

12.2. LISTING OF SUPPLIERS. Any Bidder seeking the recognition of Suppliers of equipment, materials, or supplies obtained from third party Suppliers towards achieving any mandatory or voluntary (or both) subcontracting participation goals shall provide, at a minimum, the **NAME**, **LOCATION (CITY), DIR REGISTRATION NUMBER** and the **DOLLAR VALUE** of each supplier. The Bidder will be credited up to 60% of the amount to be paid to the Suppliers for materials and supplies unless vendor manufactures or substantially alters materials and supplies, in which case, 100% will be credited. The Bidder is to indicate within the description whether the listed firm is a supplier or manufacturer. If no indication is provided, the listed firm will be credited at 60% of the listed dollar value for purposes of calculating the Subcontractor Participation Percentage.

12.3. LISTING OF SUBCONTRACTORS OR SUPPLIERS FOR ALTERNATES. For subcontractors or suppliers to be used on alternate items, bidder shall use the provided **"Subcontractors For Alternates"** form and shall indicate for each alternate subcontract whether it is an additive or deductive alternate; the subcontractor's name, location, phone number, email address, CA license number, and DIR registration number; whether the subcontractor is a designer, constructor or supplier; the type of work the subcontractor will be performing; and the dollar value of the subcontract for that alternate item. Failure to comply with this requirement may result in the bid being rejected as nonresponsive and ineligible for award.

13. SUBMITTAL OF "OR EQUAL" ITEMS: See Section 4-6, "Trade Names" in The WHITEBOOK and as amended in the SSP.

14. AWARD:

14.1. The Award of this contract is contingent upon the Contractor's compliance with all conditions precedent to Award.

14.2. Upon acceptance of a Bid, the City will prepare contract documents for execution within approximately 21 days of the date of the Bid opening and award the Contract approximately within 7 days of receipt of properly executed Contract, bonds, and insurance documents.

14.3. This contract will be deemed executed and effective only upon the signing of the Contract by the Mayor or his designee and approval as to form the City Attorney's Office.

15. **SUBCONTRACT LIMITATIONS**: The Bidder's attention is directed to Standard Specifications for Public Works Construction, Section 3-2, "SELF-PERFORMANCE" in The GREENBOOK and as amended in the SSP which requires the Contractor to self-perform not less than the specified amount. Failure to comply with this requirement shall render the bid **non-responsive** and ineligible for award.

16. **AVAILABILITY OF PLANS AND SPECIFICATIONS:** Contract Documents may be obtained by visiting the City's website: http://www.sandiego.gov/cip/. Plans and Specifications for this contract are also available for review in the office of the City Clerk or Purchasing & Contracting Department, Public Works Division.

17. **ONLY ONE BID PER CONTRACTOR SHALL BE ACCCEPTED:** No person, firm, or corporation shall be allowed to make, file, or be interested in more than one (1) Bid for the same work unless alternate Bids are called for. A person, firm or corporation who has submitted a sub-proposal to a Bidder, or who has quoted prices on materials to a Bidder, is not hereby disqualified from submitting a sub-proposal or quoting prices to other Bidders or from submitting a Bid in its own behalf. Any Bidder who submits more than one bid will result in the rejection of all bids submitted.

18. **SAN DIEGO BUSINESS TAX CERTIFICATE:** The Contractor and Subcontractors, not already having a City of San Diego Business Tax Certificate for the work contemplated shall secure the appropriate certificate from the City Treasurer, Civic Center Plaza, First floor and submit to the Contract Specialist upon request or as specified in the Contract Documents. Tax Identification numbers for both the Bidder and the listed Subcontractors must be submitted on the City provided forms within these documents.

19. **BIDDER'S GUARANTEE OF GOOD FAITH (BID SECURITY) FOR DESIGN-BID-BUILD CONTRACTS:**

19.1. For bids $250,000 and above, bidders shall submit Bid Security at bid time. Bid Security shall be in one of the following forms: a cashier's check, or a properly certified check upon some responsible bank; or an approved corporate surety bond payable to the City of San Diego for an amount of not less than 10% of the total bid amount.

19.2. This check or bond, and the monies represented thereby, will be held by the City as a guarantee that the Bidder, if awarded the contract, will in good faith enter into the contract and furnish the required final performance and payment bonds.

19.3. The Bidder agrees that in the event of the Bidder's failure to execute this contract and provide the required final bonds, the money represented by the cashier's or certified check will remain the property of the City; and the Surety agrees that it will pay to the City the damages, not exceeding the sum of 10% of the amount of the Bid, that the City may suffer as a result of such failure.

19.4. At the time of bid submission, bidders must upload and submit an electronic PDF copy of the aforementioned bid security. Whether in the form of a cashier's check, a properly certified check or an approved corporate surety bond payable to the City of San Diego, the bid security must be uploaded to the City's eBidding system. By 5PM, 1 working day after the bid opening date, all bidders must provide the City with the original bid security.

19.5. Failure to submit the electronic version of the bid security at the time of bid submission AND failure to provide the original by 5PM, 1 working day after the bid opening date shall cause the bid to be rejected and deemed **non-responsive**.

Original Bid Bond shall be submitted to:
Purchasing & Contracting Department, Public Works Division
1200 3rd Ave., Suite 200, MS 56P
San Diego, California, 92101
To the Attention of the Contract Specialist on the Front Page of this solicitation.

20. AWARD OF CONTRACT OR REJECTION OF BIDS:

20.1. This contract may be awarded to the lowest responsible and reliable Bidder.

20.2. Bidders shall complete ALL eBid forms as required by this solicitation. Incomplete eBids will not be accepted.

20.3. The City reserves the right to reject any or all Bids, to waive any informality or technicality in Bids received, and to waive any requirements of these specifications as to bidding procedure.

20.4. Bidders will not be released on account of their errors of judgment. Bidders may be released only upon receipt by the City within 3 Working Days of the bid opening, written notice from the Bidder which shows proof of honest, credible, clerical error of a material nature, free from fraud or fraudulent intent; and of evidence that reasonable care was observed in the preparation of the Bid.

20.5. A bidder who is not selected for contract award may protest the award of a contract to another bidder by submitting a written protest in accordance with the San Diego Municipal Code.

20.6. The City of San Diego will not discriminate in the award of contracts with regard to race, religion creed, color, national origin, ancestry, physical handicap, marital status, sex or age.

20.7. Each Bid package properly signed as required by these specifications shall constitute a firm offer which may be accepted by the City within the time specified herein.

20.8. The City reserves the right to evaluate all Bids and determine the lowest Bidder on the basis of the base bid and any proposed alternates or options as detailed herein.

21. BID RESULTS:

21.1. The availability of the bids on the City's eBidding system shall constitute the public announcement of the apparent low bidder. In the event that the apparent low bidder is subsequently deemed non-responsive or non-responsible, a notation of such will be

made on the eBidding system. The new ranking and apparent low bidder will be adjusted accordingly.

21.2. To obtain the bid results, view the results on the City's web site, or request the results by U.S. mail and provide a self-addressed, stamped envelope. If requesting by mail, be sure to reference the bid name and number. The bid tabulations will be mailed to you upon their completion. The results will not be given over the telephone.

22. THE CONTRACT:

22.1. The Bidder to whom award is made shall execute a written contract with the City of San Diego and furnish good and approved bonds and insurance certificates specified by the City within 14 days after receipt by Bidder of a form of contract for execution unless an extension of time is granted to the Bidder in writing.

22.2. If the Bidder takes longer than 14 days to fulfill these requirements, then the additional time taken shall be added to the Bid guarantee. The Contract shall be made in the form adopted by the City, which includes the provision that no claim or suit whatsoever shall be made or brought by Contractor against any officer, agent, or employee of the City for or on account of anything done or omitted to be done in connection with this contract, nor shall any such officer, agent, or employee be liable hereunder.

22.3. If the Bidder to whom the award is made fails to enter into the contract as herein provided, the award may be annulled and the Bidder's Guarantee of Good Faith will be subject to forfeiture. An award may be made to the next lowest responsible and reliable Bidder who shall fulfill every stipulation embraced herein as if it were the party to whom the first award was made.

22.4. Pursuant to the San Diego City Charter section 94, the City may only award a public works contract to the lowest responsible and reliable Bidder. The City will require the Apparent Low Bidder to (i) submit information to determine the Bidder's responsibility and reliability, (ii) execute the Contract in form provided by the City, and (iii) furnish good and approved bonds and insurance certificates specified by the City within 14 Days, unless otherwise approved by the City, in writing after the Bidder receives notification from the City, designating the Bidder as the Apparent Low Bidder and formally requesting the above mentioned items.

22.5. The award of the Contract is contingent upon the satisfactory completion of the above-mentioned items and becomes effective upon the signing of the Contract by the Mayor or designee and approval as to form by the City Attorney's Office. If the Apparent Low Bidder does not execute the Contract or submit required documents and information, the City may award the Contract to the next lowest responsible and reliable Bidder who shall fulfill every condition precedent to award. A corporation designated as the Apparent Low Bidder shall furnish evidence of its corporate existence and evidence that the officer signing the Contract and bond for the corporation is duly authorized to do so.

23. EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE OF WORK: The Bidder shall examine carefully the Project Site, the Plans and Specifications, other materials as described in the Special Provisions, Section 3-9, "TECHNICAL STUDIES AND SUBSURFACE DATA", and the proposal forms (e.g., Bidding Documents). The submission of a Bid shall be conclusive

evidence that the Bidder has investigated and is satisfied as to the conditions to be encountered, as to the character, quality, and scope of work, the quantities of materials to be furnished, and as to the requirements of the Bidding Documents Proposal, Plans, and Specifications.

24. CITY STANDARD PROVISIONS: This contract is subject to the following standard provisions. See The WHITEBOOK for details.

24.1. The City of San Diego Resolution No. R-277952 adopted on May 20, 1991 for a Drug-Free Workplace.

24.2. The City of San Diego Resolution No. R-282153 adopted on June 14, 1993 related to the Americans with Disabilities Act.

24.3. The City of San Diego Municipal Code §22.3004 for Contractor Standards.

24.4. The City of San Diego's Labor Compliance Program and the State of California Labor Code §§1771.5(b) and 1776.

24.5. Sections 1777.5, 1777.6, and 1777.7 of the State of California Labor Code concerning the employment of apprentices by contractors and subcontractors performing public works contracts.

24.6. The City's Equal Benefits Ordinance (EBO), Chapter 2, Article 2, Division 43 of The San Diego Municipal Code (SDMC).

24.7. The City's Information Security Policy (ISP) as defined in the City's Administrative Regulation 90.63.

25. PRE-AWARD ACTIVITIES:

25.1. The contractor selected by the City to execute a contract for this Work shall submit the required documentation as specified herein and in the Notice of Intent to Award. Failure to provide the information as specified may result in the Bid being rejected as **non-responsive.**

25.2. The decision that bid is non-responsive for failure to provide the information required within the time specified shall be at the sole discretion of the City.

BOND NO. 7901140437
PREMIUM: $23,326.00
PREMIUM IS FOR CONTRACT TERM AND IS SUBJECT TO ADJUSTMENT BASED ON FINAL CONTRACT PRICE

PROJECT: MBC GAS DETECTION SYSTEM REPLACEMENT; K-23-2127-DBB-3

PERFORMANCE BOND, LABOR AND MATERIALMEN'S BOND

FAITHFUL PERFORMANCE BOND AND LABOR AND MATERIALMEN'S BOND:

Southern Contracting Company, a corporation, as principal, and NATIONWIDE MUTUAL INSURANCE COMPANY, a corporation authorized to do business in the State of California, as Surety, hereby obligate themselves, their successors and assigns, jointly and severally, to The City of San Diego a municipal corporation in the sum of Three Million Nine Hundred Seven Thousand Ten Dollars and Zero Cents ($3,907,010.00) for the faithful performance of the annexed contract, and in the sum of Three Million Nine Hundred Seven Thousand Ten Dollars and Zero Cents ($3,907,010.00) for the benefit of laborers and materialmen designated below.

Conditions:

If the Principal shall faithfully perform the annexed contract with the City of San Diego, California, then the obligation herein with respect to a faithful performance shall be void; otherwise it shall remain in full force.

If the Principal shall promptly pay all persons, firms and corporations furnishing materials for or performing labor in the execution of this contract, and shall pay all amounts due under the California Unemployment Insurance Act then the obligation herein with respect to laborers and materialmen shall be void; otherwise it shall remain in full force.

The obligation herein with respect to laborers and materialmen shall inure to the benefit of all persons, firms and corporations entitled to file claims under the provisions of Article 2. Claimants, (iii) public works of improvement commencing with Civil Code Section 9100 of the Civil Code of the State of California.

Changes in the terms of the annexed contract or specifications accompanying same or referred to therein shall not affect the Surety's obligation on this bond, and the Surety hereby waives notice of same.

The Surety shall pay reasonable attorney's fees should suit be brought to enforce the provisions of this bond.

The Surety expressly agrees that the City of San Diego may reject any contractor or subcontractor which may be proposed by Surety in fulfillment of its obligations in the event of default by the Principal.

The Surety shall not utilize the Principal in completing the improvements and work specified in the Agreement in the event the City terminates the Principal for default.

PERFORMANCE BOND, LABOR AND MATERIALMEN'S BOND (continued)

THE CITY OF SAN DIEGO

By: Stephen Samara

Print Name: Stephen Samara
Principal Contract Specialist
Purchasing & Contracting Department

Date: 7/11/2023

APPROVED AS TO FORM

Mara W. Elliott, City Attorney

By: Dana Fairchild

Print Name: Dana Fairchild
Deputy City Attorney

Date: 7/14/2023

SOUTHERN CONTRACTING COMPANY
CONTRACTOR

By: [signature]

Print Name: PHILIP E. WATERMAN, PRESIDENT

Date: 6-1-2023

NATIONWIDE MUTUAL INSURANCE COMPANY
SURETY

By: Mark D. Iatarola
Attorney-In-Fact

Print Name: MARK D. IATAROLA, ATTORNEY-IN-FACT

Date: JUNE 1, 2023

500 NORTH BRAND BOULEVARD, SUITE 2000
GLENDALE, CA 91203

Local Address of Surety

949/606-3819

Local Phone Number of Surety

$23,326.00 PREMIUM IS FOR CONTRACT TERM AND IS SUBJECT TO ADJUSTMENT BASED ON FINAL CONTRACT PRICE

Premium

7901140437

Bond Number

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT CIVIL CODE § 1189

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of SAN DIEGO

On 6/1/2023 (*Date*) before me, SANDRA FIGUEROA, NOTARY PUBLIC (*Here Insert Name and Title of the Officer*)

personally appeared MARK D. IATAROLA (*Name(s) of Signer(s)*)

who proved to me on the basis of satisfactory evidence to be the person~~(s)~~ whose name~~(s)~~ is/~~are~~ subscribed to the within instrument and acknowledged to me that he/~~she/they~~ executed the same in his/~~her/their~~ authorized capacity~~(ies)~~, and that by his/~~her/their~~ signature~~(s)~~ on the instrument the person~~(s)~~, or the entity upon behalf of which the person~~(s)~~ acted, executed the instrument.

SANDRA FIGUEROA
COMM. # 2334108
SAN DIEGO COUNTY
NOTARY PUBLIC-CALIFORNIA
MY COMMISSION EXPIRES
SEPTEMBER 22, 2024

Place Notary Seal and/or Stamp Above

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____ (*Signature of Notary Public*)

OPTIONAL

Completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document

Title or Type of Document: _____

Document Date: _____ Number of Pages: _____

Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: MARK D. IATAROLA	Signer's Name: _____
☐ Corporate Officer – Title(s): _____	☐ Corporate Officer – Title(s): _____
☐ Partner – ☐ Limited ☐ General	☐ Partner – ☐ Limited ☐ General
☐ Individual ☒ Attorney in Fact	☐ Individual ☐ Attorney in Fact
☐ Trustee ☐ Guardian of Conservator	☐ Trustee ☐ Guardian of Conservator
☐ Other: _____	☐ Other: _____
Signer is Representing: _____	Signer is Representing: _____

Power of Attorney

KNOW ALL MEN BY THESE PRESENTS THAT:

Nationwide Mutual Insurance Company, an Ohio corporation

hereinafter referred to severally as the "Company" and collectively as "the Companies" does hereby make, constitute and appoint:
HELEN MALONEY; JOHN G MALONEY; MARK D IATAROLA; SANDRA FIGUEROA; TRACY LYNN RODRIGUEZ;

each in their individual capacity, its true and lawful attorney-in-fact, with full power and authority to sign, seal, and execute on its behalf any and all bonds and undertakings, and other obligatory instruments of similar nature, in penalties not exceeding the sum of

UNLIMITED

and to bind the Company thereby, as fully and to the same extent as if such instruments were signed by the duly authorized officers of the Company; and all acts of said Attorney pursuant to the authority given are hereby ratified and confirmed.

This power of attorney is made and executed pursuant to and by authority of the following resolution duly adopted by the board of directors of the Company:

"RESOLVED, that the president, or any vice president be, and each hereby is, authorized and empowered to appoint attorneys-in-fact of the Company, and to authorize them to execute and deliver on behalf of the Company any and all bonds, forms, applications, memorandums, undertakings, recognizances, transfers, contracts of indemnity, policies, contracts guaranteeing the fidelity of persons holding positions of public or private trust, and other writings obligatory in nature that the business of the Company may require; and to modify or revoke, with or without cause, any such appointment or authority; provided, however, that the authority granted hereby shall in no way limit the authority of other duly authorized agents to sign and countersign any of said documents on behalf of the Company."

"RESOLVED FURTHER, that such attorneys-in-fact shall have full power and authority to execute and deliver any and all such documents and to bind the Company subject to the terms and limitations of the power of attorney issued to them, and to affix the seal of the Company thereto; provided, however, that said seal shall not be necessary for the validity of any such documents."

This power of attorney is signed and sealed under and by the following bylaws duly adopted by the board of directors of the Company.

Execution of Instruments. Any vice president, any assistant secretary or any assistant treasurer shall have the power and authority to sign or attest all approved documents, instruments, contracts, or other papers in connection with the operation of the business of the company in addition to the chairman of the board, the chief executive officer, president, treasurer or secretary; provided, however, the signature of any of them may be printed, engraved, or stamped on any approved document, contract, instrument, or other papers of the Company.

IN WITNESS WHEREOF, the Company has caused this instrument to be sealed and duly attested by the signature of its officer the 20th day of August, 2021.

Antonio C. Albanese, **Vice President** of Nationwide Mutual Insurance Company

ACKNOWLEDGMENT

STATE OF NEW YORK COUNTY OF NEW YORK: ss
On this 20th day of August, 2021, before me came the above-named officer for the Company aforesaid, to me personally known to be the officer described in and who executed the preceding instrument, and he acknowledged the execution of the same, and being by me duly sworn, deposes and says, that he is the officer of the Company aforesaid, that the seal affixed hereto is the corporate seal of said Company, and the said corporate seal and his signature were duly affixed and subscribed to said instrument by the authority and direction of said Company.

Stephanie Rubino McArthur
Notary Public, State of New York
No. 02MC6270117
Qualified in New York County
Commission Expires October 19, 2024

Notary Public
My Commission Expires
October 19, 2024

CERTIFICATE

I, Laura B. Guy, Assistant Secretary of the Company, do hereby certify that the foregoing is a full, true and correct copy of the original power of attorney issued by the Company; that the resolution included therein is a true and correct transcript from the minutes of the meetings of the boards of directors and the same has not been revoked or amended in any manner; that said Antonio C. Albanese was on the date of the execution of the foregoing power of attorney the duly elected officer of the Company, and the corporate seal and his signature as officer were duly affixed and subscribed to the said instrument by the authority of said board of directors; and the foregoing power of attorney is still in full force and effect.

IN WITNESS WHEREOF, I have hereunto subscribed my name as Assistant Secretary, and affixed the corporate seal of said Company this 1ST day of JUNE, 2023.

Laura B. Guy
Assistant Secretary

BDJ 1(08-21)00

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT **CIVIL CODE § 1189**

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California)
County of San Diego)

On 06/01/2023 before me, Lynn R. Murison-Eroles, Notary Public,
Date *Here Insert Name and Title of the Officer*

personally appeared Philip E. Waterman
Name(s) of Signer(s)

,

who proved to me on the basis of satisfactory evidence to be the person~~(s)~~ whose name~~(s)~~ is~~/are~~ subscribed to the within instrument and acknowledged to me that he~~/she/they~~ executed the same in his~~/her/their~~ authorized capacity~~(ies)~~, and that by his~~/her/their~~ signature~~(s)~~ on the instrument the person~~(s)~~, or the entity upon behalf of which the person~~(s)~~ acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

LYNN R. MURISON-EROLES
Notary Public - California
San Diego County
Commission # 2329099
My Comm. Expires Jun 22, 2024

Signature Lynn R. Murison-Eroles
Signature of Notary Public

Place Notary Seal Above

OPTIONAL

Though this section is optional, completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document

Title or Type of Document: Performance Bond, Labor and Materialmen's Bond
Document Date: 06/01/2023 Number of Pages: 2
Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: Philip E. Waterman	Signer's Name: _____
☑ Corporate Officer — Title(s): _____	☐ Corporate Officer — Title(s): _____
☐ Partner — ☐ Limited ☐ General	☐ Partner — ☐ Limited ☐ General
☐ Individual ☐ Attorney in Fact	☐ Individual ☐ Attorney in Fact
☐ Trustee ☐ Guardian or Conservator	☐ Trustee ☐ Guardian or Conservator
☐ Other: _____	☐ Other: _____
Signer Is Representing: _____	Signer Is Representing: _____

ATTACHMENTS

ATTACHMENT A

SCOPE OF WORK

SCOPE OF WORK

1. **SCOPE OF WORK:** Replace the existing MSA Gas Sensors with a reduced number of sensors and replace the existing modules with the most up to date version. This will enable the Metropolitan Biosolids Center facility to provide reliable, updated gas detection sensors; thereby, providing a greater confidence for staff safety. Also included in the scope are repairs to existing irrigation per the contract documents.

1.1. The Work shall be performed in accordance with:

1.1.1. The Notice Inviting Bids and Plans numbered **42236-01-D** through **42236-165-D**, inclusive.

2. **LOCATION OF WORK:** The location of the Work is as follows:

See **Appendix E – Location Map.**

3. **CONTRACT TIME:** The Contract Time for completion of the Work shall be **292 Working Days**.

ATTACHMENT B

PHASED FUNDING PROVISIONS

PHASED FUNDING PROVISIONS

1. PRE-AWARD

1.1. Within 10 Working Days of the Notice of Intent to Award, the Contractor must contact the Project Manager to discuss fund availability for each phase and shall also submit the following:

1.1.1. Construction Cost Loaded Schedule in accordance with 6-1, "CONSTRUCTION SCHEDULE AND COMMENCEMENT OF THE WORK" and 7-3, "PAYMENT.

1.2. Contractor's failure to perform any of the following may result cancelling the award of the Contract:

1.2.1. Meeting with the City's Project Manager to discuss the Phased Funding Schedule.

1.2.2. Agreeing to a Phased Funding Schedule within **ten** days of meeting with the City's Project Manager.

2. POST-AWARD

2.1. Do not start any construction activities for the next phase until the Notice to Proceed (NTP) has been issued by the City. The City will issue a separate NTP for each phase.

2.2. The City may issue the NTP for a subsequent phase before the completion of the preceding phase.

PHASED FUNDING SCHEDULE AGREEMENT

The particulars left blank below, such as the total number of phases and the amounts assigned to each phase, will be completed with funding specific information from the Pre-Award Schedule and Construction Cost Loaded Schedule submitted to and approved by the City.

BID NUMBER: K-23-2127-DBB-3

CONTRACT OR TASK TITLE: MBC Gas Detection System

CONTRACTOR: Southern Contracting Co.

Funding Phase	Phase Description	Phase Start	Phase Finish	Not-to-Exceed Amount
1	Removal and replacement of existing gas sensors in areas 51, 60, 70 and installation of associated equipment.	NTP	8/30/2023	$1,700,000
2	Removal and replacement of existing gas sensors in areas 76, 80, 86, 94, 19 and installation of associated equipment.	9/1/2023	NOC	$ 2,207,010
3				$
			Contract Total	$3,907,010

Notes:

1) WHITEBOOK section 7-3.10, "Phased Funding Compensation" applies.
2) The total of all funding phases shall be equal to the TOTAL BID PRICE as shown on BID SCHEDULE 1 - PRICES.
3) This PHASED FUNDING SCHEDULE AGREEMENT will be incorporated into the CONTRACT and shall only be revised by written modifications to the CONTRACT.

CITY OF SAN DIEGO

PRINT NAME: Jeff Soriano
Construction Senior Engineer

Signature: _____

Date: 6/6/2023

PRINT NAME: Brian Vitelle
Design Senior Engineer

Signature: _____

Date: 6/6/2023

CONTRACTOR

PRINT NAME: Philip E. Waterman

Title: President

Signature: _____

Date: June 5, 2023

ATTACHMENT C

EQUAL OPPORTUNITY CONTRACTING PROGRAM

EQUAL OPPORTUNITY CONTRACTING PROGRAM (EOCP)

SECTION A - GENERAL REQUIREMENTS

A. INTRODUCTION.

1. This document sets forth the following specifications:
   a) The City's general EOCP requirements for all Construction Contracts.
   b) Special Provisions for Contracts subject to SLBE and ELBE requirements only.
2. Additional requirements may apply for state or federally funded projects.
3. These requirements shall be included as Contract provisions for all Subcontracts.
4. The City specified forms, instructions, and guides are available for download from the EOCP's web site at: http://www.sandiego.gov/eoc/forms/index.shtml

B. GENERAL.

1. The City of San Diego promotes equal employment and subcontracting opportunities.
2. The City is committed to ensuring that taxpayer dollars spent on public Contracts are not paid to businesses that practice discrimination in employment or subcontracting.
3. The City encourages all companies seeking to do business with the City to share this commitment.

C. DEFINITIONS.

1. For the purpose of these requirements: Terms "Bid" and "Proposal", "Bidder" and "Proposer", "Subcontractor" and "Subconsultant", "Contractor" and "Consultant", "Contractor" and "Prime Contractor", "Consultant" and "Professional Service Provider", "Suppliers" and "Vendors", "Suppliers" and "Dealers", and "Suppliers" and "Manufacturers" may have been used interchangeably.
2. The following definitions apply:
   a) **Emerging Business Enterprise (EBE)** - A for-profit business that is independently owned and operated; that is not a subsidiary or franchise of another business and whose gross annual receipts do not exceed the amount set by the City Manager and that meets all other criteria set forth in regulations implementing Municipal Code Chapter 2, Article 2, Division 36. The City Manager shall review the threshold amount for EBEs on an annual basis and adjust as necessary to reflect changes in the marketplace.
   b) **Emerging Local Business Enterprise (ELBE)** - A Local Business Enterprise that is also an Emerging Business Enterprise.

c) **Minority Business Enterprise (MBE)** - A certified business that is at least fifty-one percent (51%) owned by one or more minority individuals, or, in the case of a publicly owned business at least fifty-one percent (51%) of the stock is owned by one or more minority individuals; and (2) whose daily business operations are managed and directed by one or more minorities owners. Minorities include the groups with the following ethnic origins: African, Asian Pacific, Asian Subcontinent, Hispanic, Native Alaskan, Native American, and Native Hawaiian.

d) **Women Business Enterprise (WBE)** - A certified business that is at least fifty-one percent (51%) owned by a woman or women, or, in the case of a publicly owned business at least fifty-one percent (51%) of the stock is owned by one or more women; and (2) whose daily business operations are managed and directed by one or more women owners.

e) **Disadvantaged Business Enterprise (DBE)** - a certified business that is at least fifty-one percent (51%) owned by socially and economically disadvantaged individuals, or, in the case of a publicly owned business at least fifty-one percent (51%) of the stock is owned by one or more socially and economically disadvantaged individuals; and (2) whose daily business operations are managed and directed by one or more socially and economically disadvantaged owners.

f) **Disabled Veteran Business Enterprise (DVBE)** - A certified business that is at least fifty-one percent (51%) owned by one or more disabled veterans; and (2) business operations must be managed and controlled by one or more disabled veterans. Disabled Veteran is a veteran of the U.S. military, naval, or air service; the veteran must have a service-connected disability of at least 10% or more; and the veteran must reside in California.

g) **Other Business Enterprise (OBE)** - Any business which does not otherwise qualify as a Minority, Woman, Disadvantaged, or Disabled Veteran Business Enterprise.

h) **Small Business Enterprise (SBE)** - A for-profit business that is independently owned and operated; that is not a subsidiary or franchise of another business and whose gross annual receipts do not exceed the amount set by the City Manager and that meets all other criteria set forth in regulations implementing Municipal Code Chapter 2, Article 2, Division 36. The City Manager shall review the threshold amount for SBEs on an annual basis and adjust as necessary to reflect changes in the marketplace. A business certified as a Micro Business (MB) or a Disabled Veteran Business Enterprise (DVBE) by the State of California and that has provided proof of such certification to the City Manager shall be deemed to be an SBE.

i) **Small Local Business Enterprise (SLBE)** - A Local Business Enterprise that is also a Small Business Enterprise.

D. CITY'S EQUAL OPPORTUNITY COMMITMENT.

1. **Nondiscrimination in Contracting Ordinance.**

a) You, your Subcontractors, and Suppliers shall comply with the requirements of the City's Nondiscrimination in Contracting Ordinance, San Diego Municipal Code §§22.3501 through 22.3517.

You shall not discriminate on the basis of race, gender, gender expression, gender identity, religion, national origin, ethnicity, sexual orientation, age, or disability in the solicitation, selection, hiring, or treatment of subcontractors, vendors, or suppliers. You shall provide equal opportunity for Subcontractors to participate in subcontracting opportunities. You understand and agree that the violation of this clause shall be considered a material breach of the Contract and may result in Contract termination, debarment, or other sanctions.

You shall include the foregoing clause in all Contracts between you and your Subcontractors and Suppliers.

b) **Disclosure of Discrimination Complaints.** As part of its Bid or Proposal, you shall provide to the City a list of all instances within the past 10 years where a complaint was filed or pending against you in a legal or administrative proceeding alleging that you discriminated against your employees, Subcontractors, vendors, or suppliers, and a description of the status or resolution of that complaint, including any remedial action taken.

c) Upon the City's request, You agree to provide to the City, within 60 Calendar Days, a truthful and complete list of the names of all Subcontractors and Suppliers that you have used in the past 5 years on any of your Contracts that were undertaken within the San Diego County, including the total dollar amount paid by you for each Subcontract or supply Contract.

d) You further agree to fully cooperate in any investigation conducted by the City pursuant to the City's Nondiscrimination in Contracting Ordinance, Municipal Code §§22.3501 through 22.3517. You understand and agree that violation of this clause shall be considered a material breach of the Contract and may result in remedies being ordered against you up to and including contract termination, debarment, and other sanctions for the violation of the provisions of the Nondiscrimination in Contracting Ordinance. You further understand and agree that the procedures, remedies, and sanctions provided for in the Nondiscrimination in Contracting Ordinance apply only to violations of the Ordinance.

E. EQUAL EMPLOYMENT OPPORTUNITY OUTREACH PROGRAM.

1. You, your Subcontractors, and Suppliers shall comply with the City's Equal Employment Opportunity Outreach Program, San Diego Municipal Code §§22.2701 through 22.2707.

   You shall not discriminate against any employee or applicant for employment on any basis prohibited by law. You shall provide equal opportunity in all employment practices. You shall ensure that your Subcontractors comply with this program. Nothing in this section shall be interpreted to hold you liable for any discriminatory practices of your Subcontractors.

   You shall include the foregoing clause in all Contracts between you and your Subcontractors and Suppliers.

2. If the Contract is competitively solicited, the selected Bidder shall submit a Work Force Report (Form BB05) within 10 Working Days after receipt by the Bidder to the City for approval as specified in the Notice of Intent to Award letter.

3. The selected Bidder shall submit an Equal Employment Opportunity Plan if a Work Force Report is submitted and if the City determines that there are under-representations when compared to County Labor Force Availability data.

4. If the selected Bidder submits an Equal Employment Opportunity Plan, it shall include the following assurances:

   a) You shall maintain a working environment free of discrimination, harassment, intimidation, and coercion at all Sites and in all facilities at which your employees are assigned to Work.

   b) You shall review your EEO Policy annually with all on-Site supervisors involved in employment decisions.

   c) You shall disseminate and review your EEO Policy with all employees at least once a year, post the policy statement and EEO posters on all company bulletin boards and job sites, and document every dissemination, review, and posting with a written record to identify the time, place, employees present, subject matter, and disposition of meetings.

   d) You shall review, at least annually, all supervisors' adherence to and performance under the EEO Policy and maintain written documentation of these reviews.

   e) You shall discuss your EEO Policy Statement with Subcontractors with whom you anticipate doing business, including the EEO Policy Statement in your Subcontracts, and provide such documentation to the City upon request.

f) You shall document and maintain a record of all Bid solicitations and outreach efforts to and from Subcontractors, contractor associations, and other business associations.

g) You shall disseminate your EEO Policy externally through various media, including the media of people of color and women, in advertisements to recruit. Maintain files documenting these efforts and provide copies of these advertisements to the City upon request.

h) You shall disseminate your EEO Policy to union and community organizations.

i) You shall provide immediate written notification to the City when any union referral process has impeded your efforts to maintain your EEO Policy.

j) You shall maintain a current list of recruitment sources, including those outreaching to people of color and women, and provide written notification of employment opportunities to these recruitment sources with a record of the organizations' responses.

k) You shall maintain a current file of names, addresses and phone numbers of each walk-in applicant, including people of color and women, and referrals from unions, recruitment sources, or community organizations with a description of the employment action taken.

l) You shall encourage all present employees, including people of color and women employees, to recruit others.

m) You shall maintain all employment selection process information with records of all tests and other selection criteria.

n) You shall develop and maintain documentation for on-the-job training opportunities, participate in training programs, or both for all of your employees, including people of color and women, and establish apprenticeship, trainee, and upgrade programs relevant to your employment needs.

o) You shall conduct, at least annually, an inventory and evaluation of all employees for promotional opportunities and encourage all employees to seek and prepare appropriately for such opportunities.

p) You shall ensure that the company's working environment and activities are non-segregated except for providing separate or single-user toilets and necessary changing facilities to assure privacy between the sexes.

F. SUBCONTRACTING.

1. The City encourages all eligible business enterprises to participate in City contracts as a Contractor, Subcontractor, and joint venture partner with you, your Subcontractors, or your Suppliers. You are encouraged to take positive steps to diversify and expand your Subcontractor solicitation base and to offer

subcontracting opportunities to all eligible business firms including SLBEs, ELBEs, MBEs, WBEs, DBEs, DVBEs, and OBEs.

2. For Subcontractor participation level requirements, see the Contract Documents where applicable.

3. For the purposes of achieving the mandatory Subcontractor participation percentages, City percentage calculations will not account for the following:

   a) "Field Orders" and "City Contingency" Bid items.

   b) Alternate Bid items.

   c) Allowance Bid items designated as "EOC Type II".

4. Allowance Bid items designated as "EOC Type I" will be considered as part of the Base Bid and will be included in the percentage calculation.

5. Each joint venture partner shall be responsible for a clearly defined Scope of Work. In addition, an agreement shall be submitted and signed by all parties identifying the extent to which each joint venture partner shares in ownership, control, management, risk, and profits of the joint venture.

G. LISTS OF SUBCONTRACTORS AND SUPPLIERS.

1. You shall comply with the Subletting and Subcontracting Fair Practices Act, Public Contract Code §§4100 through 4113, inclusive.

2. You shall list all Subcontractors who will receive more than 0.5% of the total Bid amount or $10,000, whichever is greater on the form provided in the Contract Documents (Subcontractors list).

3. The Subcontractors list shall include the Subcontractor's name, telephone number including area code, physical address, Scope of Work, the dollar amount of the proposed Subcontract, the California contractor license number, the Public Works contractor registration number issued pursuant to Section 1725.5 of the Labor Code, and the Subcontractor's certification status with the name of the certifying agency.

4. The listed Subcontractor shall be appropriately licensed pursuant to Contractor License Laws.

5. For Design-Build Contracts, refer to the RFQ and RFP for each Project or Task Order.

H. SUBCONTRACTOR AND SUPPLIER SUBSTITUTIONS.

1. Listed Subcontractors and Suppliers shall not be substituted without the Express authorization of the City or its duly authorized agent.

2. Request for Subcontractor or Supplier substitution shall be made in writing to Purchasing & Contracting Department, Public Works Division, Attention Contract Specialist, 1200 3rd Ave., Suite 200, MS 56P, San Diego, CA 92101 with a copy to the Engineer.

3. The request shall include a thorough explanation of the reason(s) for the substitution, including dollar amounts and a letter from each substituted Subcontractor or Supplier stating that they (the Subcontractors or Suppliers) release all interest in working on the Project and written confirmation from the new Subcontractor or Supplier stating that they agree to work on the Project along with the dollar value of the Work to be performed.

4. Written approval of the substitution request shall be received by you or from the City or its authorized officer prior to any unlisted Subcontractor or Supplier performing Work on the Project.

5. Substitution of Subcontractors and Suppliers without authorization shall subject you to those penalties set forth in Public Contract Code §4110.

6. Requests for Supplier substitution shall be made in writing at least 10 Days prior to the provision of materials, supplies, or services by the proposed Supplier and shall include proof of written notice to the originally listed Supplier of the proposed substitution.

7. A Contractor whose Bid is accepted shall not:

    a) Substitute a person as Subcontractor or Supplier in place of the Subcontractor or Supplier listed in the original bid, except that the City, or it's duly authorized officer, may consent to the substitution of another person as a Subcontractor or Supplier in any of the following situations:

        i. When the Subcontractor or Supplier listed in the Bid, after having a reasonable opportunity to do so, fails or refuses to execute a written Contract for the scope of work specified in the subcontractor's bid and at the price specified in the subcontractor's bid, when that written contract, based upon the general terms, conditions, plans, and specifications for the project involved or the terms of the subcontractor's written bid, is presented to the subcontractor by the prime contractor.

        ii. When the listed Subcontractor or Supplier becomes insolvent or the subject of an order for relief in bankruptcy.

        iii. When the listed Subcontractor or Supplier fails or refuses to perform his or her subcontract.

        iv. When the listed Subcontractor fails or refuses to meet bond requirements as set forth in Public Contract Code §4108.

        v. When you demonstrate to the City or it's duly authorized officer, subject to the provisions set forth in Public Contract Code §4107.5, that the name of the Subcontractor was listed as the result of an inadvertent clerical error.

        vi. When the listed Subcontractor is not licensed pursuant to Contractor License Law.

vii. When the City, or it's duly authorized officer, determines that the Work performed by the listed Subcontractor or that the materials or supplies provided by the listed Supplier are substantially unsatisfactory and not in substantial accordance with the Plans and specifications or that the Subcontractor or Supplier is substantially delaying or disrupting the progress of the Work.

viii. When the listed Subcontractor is ineligible to work on a public works project pursuant to §§1777.1 or 1777.7 of the Labor Code.

ix. When the City or its duly authorized agent determines that the listed Subcontractor is not a responsible contractor.

b) Permit a Contract to be voluntarily assigned or transferred or allow it to be performed by anyone other than the original Subcontractor, Supplier listed in the original Bid without the consent of the City, or it's duly authorized officer.

c) Other than in the performance of "Change Orders" causing changes or deviations from the Contract, sublet or subcontract any portion of the Work, or contract for materials or supplies in excess of 0.5% of your total bid or $10,000, whichever is greater, as to which his or her original Bid did not designate a Subcontractor or Supplier.

8. Following receipt of notice from you of the proposed substitution of a Subcontractor or Supplier, the listed Subcontractor or Supplier who has been so notified shall have 5 Working Days within which to submit written objections to the substitution to the Contract Specialist with a copy to the Engineer. Failure to file these written objections shall constitute the listed Subcontractor or Supplier's consent to the substitution. If written objections are filed, the City shall give notice in writing of at least 5 Working Days to the listed Subcontractor or Supplier of a hearing by the City on your request for substitution.

I. PROMPT PAYMENT.

1. You or your Subcontractors shall pay to any subcontractor, not later than 7 Calendar Days of receipt of each progress payment, unless otherwise agreed to in writing, the respective amounts allowed you on account of the Work performed by the Subcontractors, to the extent of each Subcontractor's interest therein. In cases of Subcontractor performance deficiencies, you shall make written notice of any withholding to the Subcontractor with a copy to the Contracts Specialist. Upon correction of the deficiency, you shall pay the Subcontractor the amount previously withheld within 14 Calendar Days after payment by the City.

2. Any violation of California Business and Professions Code, §7108.5 concerning prompt payment to Subcontractors shall subject the violating Contractor or

Subcontractor to the penalties, sanctions, and other remedies of that section. This requirement shall not be construed to limit or impair any contractual, administrative, or judicial remedies otherwise available to you or your Subcontractor in the event of a dispute involving late payment or nonpayment by the Prime Contractor, deficient subcontract performance, or noncompliance by a Subcontractor.

J. PROMPT PAYMENT OF FUNDS WITHHELD TO SUBCONTRACTORS.

1. The City will hold retention from you and will make prompt and regular incremental acceptances of portions, as determined by the Engineer, of the Work and pay retention to you based on these acceptances.

2. You or your Subcontractors shall return all monies withheld in retention from a Subcontractor within 30 Calendar Days after receiving payment for Work satisfactorily completed and accepted including incremental acceptances of portions of the Work by the City.

3. Federal law (49CFR26.29) requires that any delay or postponement of payment over 30 Calendar Days may take place only for good cause and with the City's prior written approval. Any violation of this provision by you or your Subcontractor shall subject you or your Subcontractor to the penalties, sanctions, and other remedies specified in §7108.5 of the Business and Professions Code.

4. These requirements shall not be construed to limit or impair any contractual, administrative, or judicial remedies otherwise available to you or your Subcontractor in the event of a dispute involving late payment or nonpayment by you, deficient subcontract performance, or noncompliance by a Subcontractor.

K. CERTIFICATION.

1. The City accepts certifications of DBE, DVBE, MBE, SMBE, SWBE, or WBE by any of the following certifying agencies:

   a) Current certification by the State of California Department of Transportation (CALTRANS) as DBE, SMBE, or SWBE.

   b) Current MBE, WBE, or DVBE certification from the California Public Utilities Commission.

   c) DVBE certification is received from the State of California's Department of General Services, Office of Small and Minority Business.

   d) Current certification by the City of Los Angles as DBE, WBE, or MBE.

   e) Subcontractors' valid proof of certification status (copies of MBE, WBE, DBE, or DVBE certifications) shall be submitted as required.

L. CONTRACT RECORDS AND REPORTS.

1. You shall maintain records of all subcontracts and invoices from your Subcontractors and Suppliers for work on this project. Records shall show name, telephone number including area code, and business address of each Subcontractor, Supplier, and joint venture partner, and the total amount actually paid to each firm. Project relevant records, regardless of tier, may be periodically reviewed by the City.

2. You shall retain all records, books, papers, and documents pertinent to the Contract for a period of not less than 5 years after Notice of Completion and allow access to said records by the City's authorized representatives.

3. You shall submit the following reports using the City's web-based contract compliance (Prism® portal):

    a. **Monthly Payment.** You shall submit Monthly Payment Reporting by the 10th day of the subsequent month. Incomplete and/or delinquent reporting may cause payment delays, non-payment of invoices, or both.

4. The records maintained under item 1, described above, shall be consolidated into a Final Summary Report, certified as correct by an authorized representative of the Contractor. The Final Summary Report shall include all subcontracting activities and be sent to the EOCP Program Manager prior to Acceptance. Failure to comply may result in assessment of liquidated damages or withholding of retention. The City will review and verify 100% of subcontract participation reported in the Final Summary Report prior to approval and release of final retention to you. In the event your Subcontractors are owed money for completed Work, the City may authorize payment to subcontractor via a joint check from the withheld retention.

EQUAL OPPORTUNITY CONTRACTING PROGRAM (EOCP)

SECTION B - SLBE-ELBE SUBCONTRACTING REQUIREMENTS

THESE SPECIAL PROVISIONS SUPPLEMENT THE POLICIES AND REQUIREMENTS ESTABLISHED BY THE CITY OF SAN DIEGO EQUAL OPPORTUNITY CONTRACTING PROGRAM SPECIFIED IN THE CITY'S GENERAL EOCP REQUIREMENTS.

A. GENERAL.

1. It is the City's policy to encourage greater availability, capacity development, and contract participation by SLBE and ELBE firms in City contracts. This policy is, in part, intended to further the City's compelling interest to stimulate economic development through the support and empowerment of the local community, ensure that it is neither an active nor passive participant in marketplace discrimination, and promote equal opportunity for all segments of the contracting community.

2. The City is committed to maximizing subcontracting opportunities for all qualified and available firms.

3. This policy applies to City-funded construction contracts. Bidders shall be fully informed of this policy as set forth in these specifications. Mandatory or voluntary subcontracting percentages, Bid Discounts, and restricted competitions are specified in the Contract Documents.

4. You shall make subcontracting opportunities available to a broad base of qualified Subcontractors and shall achieve the minimum SLBE-ELBE Subcontractor participation identified for your project.

5. Failure to subcontract the specified minimum (mandatory) percentages of the Bid to qualified available SLBE-ELBE Subcontractors will cause a Bid to be rejected as non-responsive unless the Bidder has demonstrated compliance with the affirmative steps as specified in the City's document titled "Small Local Business (SLBE) Program, INSTRUCTIONS FOR BIDDERS COMPLETING THE GOOD FAITH EFFORT SUBMITTAL" and has submitted documentation showing that all required positive efforts were made prior to the Bid submittal due date. The required Good Faith Effort (GFE) documentation shall be submitted to the Contract Specialist. The instructions for completing the good faith effort submittal can be found on the City's website:

   https://www.sandiego.gov/sites/default/files/legacy/eoc/pdf/slbegfeinst.pdf

6. The current list of certified SLBE-ELBE firms and information for completing the GFE submittal can be found on the City's EOC Department website:

   http://www.sandiego.gov/eoc/programs/slbe.shtml

7. These requirements may be waived, at the City's sole discretion, on projects deemed inappropriate for subcontracting participation.

B. DEFINITIONS.

1. The following definitions shall be used in conjunction with these specifications:

   a) **Bid Discount** – Additional inducements or enhancements in the bidding process that are designed to increase the chances for the selection of SLBE firms in competition with other firms.

   b) **Commercially Useful Function** – An SLBE-ELBE performs a commercially useful function when it is responsible for the execution of the Work and is carrying out its responsibilities by actually performing, managing, and supervising the Work involved. To perform a commercially useful function, the SLBE-ELBE shall also be responsible, with respect to materials and supplies used on the Contract, for negotiating price, determining quantity and quality, ordering the material, and installing (where applicable) and paying for the material itself.

      To determine whether an SLBE-ELBE is performing a commercially useful function, an evaluation will be performed of the amount of Work subcontracted, normal industry practices, whether the amount the SLBE-ELBE firm is to be paid under the contract is commensurate with the Work it is actually performing and the SLBE-ELBE credit claimed for its performance of the Work, and other relevant factors. Specifically, an SLBE-ELBE does not perform a commercially useful function if its role is limited to that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of meaningful and useful SLBE-ELBE participation, when in similar transactions in which SLBE-ELBE firms do not participate, there is no such role performed.

   c) **Good Faith Efforts (GFE)** – Documentation of the Bidder's intent to comply with SLBE Program goals and procedures included in the City's SLBE Program, Instructions for Completing Good Faith Effort Submittal available from the City's EOCP website or the Contract Specialist.

   d) **Independently Owned, Managed, and Operated** – Ownership of a SLBE-ELBE firm shall be direct, independent, and by individuals only. Business firms that are owned by other businesses or by the principals or owners of other businesses that cannot themselves qualify under the SLBE-ELBE eligibility requirements shall not be eligible to participate in the Program. Moreover, the day-to-day management of the SLBE-ELBE firm shall be direct and independent of the influence of any other businesses that cannot themselves qualify under the SLBE-ELBE eligibility requirements.

   e) **Joint Venture** – An association of two or more persons or business entities that is formed for the single purpose of carrying out a single defined business enterprise for which purpose they combine their

capital, efforts, skills, knowledge, or property. Joint ventures shall be established by written agreement to qualify for this program.

f) **Local Business Enterprise ("LBE")** – A firm having a Principal Place of Business and a Significant Employment Presence in San Diego County, California that has been in operation for 12 consecutive months and a valid business tax certificate. This definition is subsumed within the definition of Small Local Business Enterprise.

g) **Minor Construction Program** – A program developed for bidding exclusively among SLBE-ELBE Construction firms.

h) **Principal Place of Business** – A location wherein a firm maintains a physical office and through which it obtains no less than 50% of its overall customers or sales dollars.

i) **Protégé** – A firm that has been approved and is an active participant in the City's Mentor-Protégé Program and that has signed the required program participation agreement and has been assigned a mentor.

j) **Significant Employee Presence** – No less than 25% of a firm's total number of employees are domiciled in San Diego County.

C. SUBCONTRACTOR PARTICIPATION.

1. For the purpose of satisfying subcontracting participation requirements, only 1st tier SLBE–ELBE Subcontractors will be recognized as participants in the Contract according to the following criteria:

   a) For credit to be allowed toward a respective participation level, all listed SLBE-ELBE firms shall have been certified by the Bid due date.

   b) The Subcontractor shall perform a commercially useful function for credit to be allowed toward subcontractor participation levels. The Subcontractor shall be required by you to be responsible for the execution of a distinct element of the Work and shall carry out its responsibility by actually performing and supervising its own workforce.

   c) If the Bidder is seeking the recognition of materials, supplies, or both towards achieving any mandatory subcontracting participation level, the Bidder shall indicate on Form AA40 – Named Equipment/Material Supplier List with the Bid the following:

      i. If the materials or supplies are obtained from a SLBE-ELBE manufacturer, the Bidder will receive 100% of the cost of the materials or supplies toward SLBE participation. For the purposes of counting SLBE-ELBE participation, a manufacturer is a firm that operates or maintains a factory or establishment that produces, on the premises, the materials, supplies, articles, or equipment required under the Contract and of the general character described by the specifications.7-

ii. If the materials or supplies are obtained from a SLBE-ELBE supplier, the Bidder will receive 60% of the cost of the materials or supplies toward SLBE participation. For the purposes of counting SLBE-ELBE participation a Supplier is a firm that owns, operates, or maintains a store, warehouse, or other establishment in which the materials, supplies, articles or equipment of the general character described by the specifications and required under the Contract are bought, kept in stock, and regularly sold or leased to the public in the usual course of business. To be a supplier, the firm shall be an established, regular business that engages, as its principal business and under its own name, in the purchase and sale or lease of the products in question. A person may be a supplier in such bulk items as petroleum products, steel, cement, gravel, stone, or asphalt without owning, operating, or maintaining a place of business if the person both owns and operates distribution equipment for the products. Any supplementing of the suppliers' own distribution equipment shall be by a long-term lease agreement and shall not be on an ad hoc or contract-by-contract basis.

iii. If the materials or supplies are obtained from a SLBE-ELBE, which is neither a manufacturer nor a supplier, the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, fees or transportation charges for the delivery of materials or supplies required on a job site will be counted toward SLBE-ELBE participation, provided the fees are reasonable and not excessive as compared with fees customarily allowed for similar services. No portion of the cost of the materials and supplies themselves will be counted toward SLBE-ELBE participation.

d) If the Bidder is seeking the recognition of SLBE-ELBE Trucking towards achieving any mandatory subcontracting participation level, the Bidder shall indicate it on Form AA35 – List of Subcontractors with the Bid. The following factors will be evaluated in determining the credit to be allowed toward the respective participation level:

i. The SLBE-ELBE shall be responsible for the management and supervision of the entire trucking operation for which it is getting credit on a particular Contract and there shall not be a contrived arrangement for the purpose of counting SLBE-ELBE participation.

ii. The SLBE-ELBE shall itself own and operate at least 1 fully licensed, insured, and operational truck used on the Contract.

iii. The SLBE-ELBE receives credit for the total value of the transportation services it provides on the Contract using trucks it owns, insures, and operates using drivers it employs.

iv. The SLBE-ELBE may lease trucks from another SLBE-ELBE firm including an owner-operator who is certified as a SLBE-ELBE. The SLBE-ELBE who leases trucks from another SLBE-ELBE receives credit for the total value of the transportation services the lessee SLBE-ELBE provides on the contract.

v. The SLBE-ELBE may also lease trucks from a non-SLBE-ELBE firm, including an owner-operator. The SLBE-ELBE who leases trucks from a non-SLBE-ELBE is entitled to credit for the total value of transportation services provided by non-SLBE-ELBE lessees not to exceed the value of transportation services provided by SLBE-ELBE owned trucks on the contract. Additional participation by non-SLBE-ELBE lessees receive credit only for the fee or commission it receives as a result of the lease arrangement.

vi. A lease shall indicate that the SLBE-ELBE has exclusive use of and control over the truck. This does not preclude the leased truck from working for others during the term of the lease with the consent of the SLBE-ELBE so long as the lease gives the SLBE-ELBE absolute priority for use of the leased truck.

D. SLBE-ELBE SUBCONTRACTOR PARTICIPATION PERCENTAGES.

1. Contracts valued at $1,500,000 and above will be considered Major Public Works Contracts and will include a mandatory Subcontractor participation requirement for SLBE–ELBE firms.

   a) The Bidder shall achieve the mandatory Subcontractor participation requirement or demonstrate GFE.

   b) The Bidders shall indicate the participation on Forms AA35 - List of Subcontractors and AA40 - Named Equipment/Material Supplier List as applicable regardless of the dollar value.

   c) An SLBE-ELBE Bidder may count its own participation toward achieving the mandatory goal as long as the SLBE-ELBE Bidder performs 51% of the Contract Price.

2. Contracts Valued over $1,000,000 and under $1,500,000 will also be considered Major Public Works Contracts and will include the mandatory subcontractor participation requirements described above and the following:

   a) 5% bid discount for SLBE-ELBE firms.

   b) Non-certified Contractor will receive 5% bid discount if they achieve the specified mandatory Subcontracting participations.

c) Bid discounts shall not apply if the award will result in a total contract cost of $50,000 in excess of the apparent lowest Bid.

d) In the event of a tie bid between a SLBE-ELBE Bidder and a non-SLBE-ELBE Bidder, the SLBE-ELBE Bidder will be awarded the Contract.

e) In the event of a tie bid between a discounted Bid and a non-discounted Bid, the discounted Bid will be awarded the Contract.

3. Contracts valued over $500,000 up to $1,000,000 will be considered Minor Public Works Contracts and will be awarded through a competitive Bid process open only to City certified SLBE-ELBE firms. If there are no bidders or no responsible bidders, the Contract will be made available to all Bidders and will be subject to requirements listed in items 1 and 2 for Major Public Works Contracts above.

4. Contracts valued at $500,000 and below will also be considered Minor Public Works Contracts and will be awarded through a competitive bid process open only to City certified ELBEs unless there are less than 2 firms available at which it will be awarded through a competitive process open only to the City certified SLBE-ELBE firms. If there are no bidders or no responsible bidders, the Contract will be made available to all Bidders and subject to requirements listed in items 1 and 2 for Major Public Works Contracts above.

E. JOINT VENTURES.

1. The City may allow for Joint Venture bid discounts on some Contracts. Contracts that allow for Joint Venture bid discounts will be designated in Bid documents. A firm that is bidding or competing for City Contracts may partner with a certified SLBE or ELBE to compete for Contracts as a Joint Venture.

2. A Joint Venture shall be between two entities with the same discipline or license as required by the City. Joint ventures will receive bid discounts depending on the SLBE or ELBE percentage of participation. To be eligible for a discount, a Joint Venture Agreement shall be approved by the City at the time of Bid submittal. The maximum allowable discount shall be 5%. The parties shall agree to enter in the relationship for the life of the projects.

3. Joint Venture shall submit a Joint Venture Management Plan, a Joint Venture Agreement, or both at least 2 weeks prior to the Bid due date. Copies of the Joint Venture applications are available upon request to the Contract Specialist. Each agreement or management plan shall include the following:

a) Detailed explanation of the financial contribution for each partner.

b) List of personnel and equipment used by each partner.

c) Detailed breakdown of the responsibilities of each partner.

d) Explanation of how the profits and losses will be distributed.

e) Description of the bonding capacity of each partner.

f) Management or incentive fees available for any one of the partners (if any).

4. Each Joint Venture partner shall perform a Commercially Useful Function. An SLBE or ELBE that relies on the resources and personnel of a non-SLBE or ELBE firm will not be deemed to perform a Commercially Useful Function.

5. Each Joint Venture partner shall possess licenses appropriate for the discipline for which a proposal is being submitted. If a Joint Venture is bidding on a single trade project, at the time of bid submittal, each Joint Venture partner shall possess the requisite specialty license for that trade bid.

6. The SLBE or ELBE partner shall clearly define the portion of the Work to be performed. This Work shall be of the similar type of Work the SLBE or ELBE partner performs in the normal course of its business. The Joint Venture Participation Form shall specify the Bid items to be performed by each individual Joint Venture partner. Lump sum Joint Venture participation shall not be acceptable.

7. Responsibilities of the SLBE or ELBE Joint Venture Partner:

   a) The SLBE or ELBE partner shall share in the control, management responsibilities, risks and profits of the Joint Venture in proportion with the level of participation in the project.

   b) The SLBE or ELBE partner shall perform Work that is commensurate with its experience.

   c) The SLBE or ELBE partner shall use its own employees and equipment to perform its portion of the Work.

   d) The Joint Venture as a whole shall perform Bid items that equal or exceed 50% of the Contract Price, excluding the cost of manufactured items, in order to be eligible for a Joint Venture discount.

F. MAINTAINING PARTICIPATION LEVELS.

1. Credit and preference points are earned based on the level of participation proposed prior to the award of the Contract. Once the Project begins you shall achieve and maintain the SLBE-ELBE participation levels for which credit and preference points were earned. You shall maintain the SLBE-ELBE percentages indicated at the Award of Contract and throughout the Contract Time.

2. If the City modifies the original Scope of Work, you shall make reasonable efforts to maintain the SLBE-ELBE participation for which creditor preference points were earned. If participation levels will be reduced, approval shall be received from the City prior to making changes.

3. You shall notify and obtain written approval from the City in advance of any reduction in subcontract scope, termination, or substitution for a designated SLBE-ELBE Subcontractor. Failure to do so shall constitute a material breach of the Contract.

4. If you fail to maintain the SLBE-ELBE participation listed at the time the Contract is awarded and have not received prior approval from the City, the

City may declare you in default and will be considered grounds for debarment under Chapter 2, Article 2, Division 8, of the San Diego Municipal Code.

G. SUBCONTRACTING EFFORTS REVIEW AND EVALUATION.

1. Documentation of your subcontracting efforts will be reviewed by EOCP to verify that you made subcontracting opportunities available to a broad base of qualified Subcontractors, negotiated in good faith with interested Subcontractors, and did not reject any bid for unlawful discriminatory reasons. The EOCP review is based on the federal "Six Good Faith Efforts" model.

2. The GFEs are required methods to ensure that all ELBE and SLBE firms have had the opportunity to compete for the City's Public Works procurements. The Six Good Faith Efforts, also known as affirmative steps, attract and utilize ELBE and SLBE firms:

   a) Ensure ELBE firms are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities.

   b) Make information of forthcoming opportunities available to SLBE-ELBE firms and arrange time for Contracts and establish delivery schedules, where requirements permit, in a way that encourages and facilitates participation by SLBE-ELBE firms in the competitive process. This includes posting solicitations for Bids or proposals to SLBE-ELBE firms for a minimum of 10 Working Days before the Bid or Proposal due date.

   c) Consider in the contracting process whether firms competing for large Contracts could subcontract with SLBE-ELBE firms.

   d) Encourage contracting with a consortium of ELBE-SLBE firms when a Contract is too large for one of these firms to handle individually.

   e) Use the services and assistance of the City's EOC Office and the SLBE-ELBE Directory.

   f) If you award subcontracts, require your Subcontractors to take the steps listed above.

H. GOOD FAITH EFFORT DOCUMENTATION.

1. If the specified SLBE-ELBE Subcontractor participation percentages are not met, you shall submit information necessary to establish that adequate GFEs were taken to meet the Contract Subcontractor participation percentages. See the City's document titled "Small Local Business (SLBE) Program, INSTRUCTIONS FOR BIDDERS COMPLETING THE GOOD FAITH EFFORT SUBMITTAL." The instructions for completing the good faith effort submittal can be found on the City's website:

   https://www.sandiego.gov/sites/default/files/legacy/eoc/pdf/slbegfeinst.pdf

I. SUBCONTRACTOR SUBSTITUTION.

1. Evidence of fraud or discrimination in the substitution of Subcontractors will result in sanctions including assessment of penalty fines, termination of Contract, or debarment. This section does not replace applicable California Public Contract Code.

J. FALSIFICATION OF SUB-AGREEMENT AND FRAUD.

1. Falsification or misrepresentation of a sub-agreement as to company name, Contract amount or actual Work performed by Subcontractors, or any falsification or fraud on the part your submission of documentation and forms pursuant to this program, will result in sanctions against you including assessment of penalty fines, termination of the Contract, or debarment. Instances of falsification or fraud which are indicative of an attempt by you to avoid subcontracting with certain categories of Subcontractors on the basis of race, gender, gender expression, gender identity, religion, national origin, ethnicity, sexual orientation, age, or disability shall be referred to the Equal Opportunity Contracting Program's Investigative Unit for possible violations of Article 2, Division 35 of the City Administrative Code, §§22.3501 et seq. (Nondiscrimination in Contracting).

K. RESOURCES.

1. The current list of certified SLBE-ELBE firms and information for completing the GFE submittal can be found on the City's EOC Department website:

   http://www.sandiego.gov/eoc/programs/slbe.shtml

ATTACHMENT D

PREVAILING WAGE

PREVAILING WAGE

1. **PREVAILING WAGE RATES:** Pursuant to San Diego Municipal Code section 22.3019, construction, alteration, demolition, repair and maintenance work performed under this Contract is subject to State prevailing wage laws. For construction work performed under this Contract cumulatively exceeding $25,000 and for alteration, demolition, repair and maintenance work performed under this Contract cumulatively exceeding $15,000, the Contractor and its subcontractors shall comply with State prevailing wage laws including, but not limited to, the requirements listed below.

   1.1. Compliance with Prevailing Wage Requirements. Pursuant to sections 1720 through 1861 of the California Labor Code, the Contractor and its subcontractors shall ensure that all workers who perform work under this Contract are paid not less than the prevailing rate of per diem wages as determined by the Director of the California Department of Industrial Relations (DIR). This includes work performed during the design and preconstruction phases of construction including, but not limited to, inspection and land surveying work.

      1.1.1. Copies of such prevailing rate of per diem wages are on file at the City and are available for inspection to any interested party on request. Copies of the prevailing rate of per diem wages also may be found at http://www.dir.ca.gov/OPRL/DPreWageDetermination.htm. Contractor and its subcontractors shall post a copy of the prevailing rate of per diem wages determination at each job site and shall make them available to any interested party upon request.

      1.1.2. The wage rates determined by the DIR refer to expiration dates. If the published wage rate does not refer to a predetermined wage rate to be paid after the expiration date, then the published rate of wage shall be in effect for the life of this Contract. If the published wage rate refers to a predetermined wage rate to become effective upon expiration of the published wage rate and the predetermined wage rate is on file with the DIR, such predetermined wage rate shall become effective on the date following the expiration date and shall apply to this Contract in the same manner as if it had been published in said publication. If the predetermined wage rate refers to one or more additional expiration dates with additional predetermined wage rates, which expiration dates occur during the life of this Contract, each successive predetermined wage rate shall apply to this Contract on the date following the expiration date of the previous wage rate. If the last of such predetermined wage rates expires during the life of this Contract, such wage rate shall apply to the balance of the Contract.

   1.2. Penalties for Violations. Contractor and its subcontractors shall comply with California Labor Code section 1775 in the event a worker is paid less than the prevailing wage rate for the work or craft in which the worker is employed. This shall be in addition to any other applicable penalties allowed under Labor Code sections 1720 – 1861.

1.3. **Payroll Records.** Contractor and its subcontractors shall comply with California Labor Code section 1776, which generally requires keeping accurate payroll records, verifying and certifying payroll records, and making them available for inspection. Contractor shall require its subcontractors to also comply with section 1776. Contractor and its subcontractors shall submit weekly certified payroll records online via the City's web-based Labor Compliance Program. Contractor is responsible for ensuring its subcontractors submit certified payroll records to the City.

1.3.1. Contractor and their subcontractors shall also furnish records specified in Labor Code section 1776 directly to the Labor Commissioner in the manner required by Labor Code section 1771.4.

1.4. **Apprentices.** Contractor and its subcontractors shall comply with California Labor Code sections 1777.5, 1777.6 and 1777.7 concerning the employment and wages of apprentices. Contractor is held responsible for the compliance of their subcontractors with sections 1777.5, 1777.6 and 1777.7.

1.5. **Working Hours.** Contractor and their subcontractors shall comply with California Labor Code sections 1810 through 1815, including but not limited to: (i) restrict working hours on public works contracts to eight hours a day and forty hours a week, unless all hours worked in excess of 8 hours per day are compensated at not less than 1½ times the basic rate of pay; and (ii) specify penalties to be imposed on contractors and subcontractors of $25 per worker per day for each day the worker works more than 8 hours per day and 40 hours per week in violation of California Labor Code sections1810 through 1815.

1.6. **Required Provisions for Subcontracts.** Contractor shall include at a minimum a copy of the following provisions in any contract they enter into with a subcontractor: California Labor Code sections 1771, 1771.1, 1775, 1776, 1777.5, 1810, 1813, 1815, 1860 and 1861.

1.7. **Labor Code Section 1861 Certification.** Contractor in accordance with California Labor Code section 3700 is required to secure the payment of compensation of its employees and by signing this Contract, Contractor certifies that "I am aware of the provisions of Section 3700 of the California Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this Contract."

1.8. **Labor Compliance Program**. The City has its own Labor Compliance Program authorized in August 2011 by the DIR. The City will withhold contract payments when payroll records are delinquent or deemed inadequate by the City or other governmental entity, or it has been established after an investigation by the City or other governmental entity that underpayment(s) have occurred. For questions or assistance, please contact the City of San Diego's Prevailing Wage Unit at 858-627-3200.

1.9. Contractor and Subcontractor Registration Requirements. This project is subject to compliance monitoring and enforcement by the DIR. A contractor or subcontractor shall not be qualified to bid on, be listed in a bid or proposal, subject to the requirements of section 4104 of the Public Contract Code, or engage in the performance of any contract for public work, unless currently registered and qualified to perform public work pursuant to Labor Code section 1725.5 It is not a violation of this section for an unregistered contractor to submit a bid that is authorized by Section 7029.1 of the Business and Professions code or by Section 10164 or 20103.5 of the Public Contract Code, provided the contractor is registered to perform public work pursuant to Section 1725.5 at the time the contract is awarded.

1.9.1. A Contractor's inadvertent error in listing a subcontractor who is not registered pursuant to Labor Code section 1725.5 in response to a solicitation shall not be grounds for filing a bid protest or grounds for considering the bid non-responsive provided that any of the following apply: (1) the subcontractor is registered prior to bid opening; (2) within twenty-four hours after the bid opening, the subcontractor is registered and has paid the penalty registration fee specified in Labor Code section 1725.5; or (3) the subcontractor is replaced by another registered subcontractor pursuant to Public Contract Code section 4107.

1.9.2. By submitting a bid or proposal to the City, Contractor is certifying that he or she has verified that all subcontractors used on this public work project are registered with the DIR in compliance with Labor Code sections 1771.1 and 1725.5, and Contractor shall provide proof of registration for themselves and all listed subcontractors to the City at the time of bid or proposal due date or upon request.

1.10. Stop Order. For Contractor or its subcontractors engaging in the performance of any public work contract without having been registered in violation of Labor Code sections 1725.5 or 1771.1, the Labor Commissioner shall issue and serve a stop order prohibiting the use of the unregistered contractors or unregistered subcontractor(s) on ALL public works until the unregistered contractor or unregistered subcontractor(s) is registered. Failure to observe a stop order is a misdemeanor.

1.11. List of all Subcontractors. The Contractor shall provide the list of subcontractors (regardless of tier), along with their DIR registration numbers, utilized on this Contract prior to any work being performed; and the Contractor shall provide a complete list of all subcontractors with each invoice. Additionally, Contractor shall provide the City with a complete list of all subcontractors (regardless of tier) utilized on this contract within ten working days of the completion of the contract, along with their DIR registration numbers. The City shall withhold final payment to Construction Management Professional until at least thirty (30) days after this information is provided to the City.

1.12. Exemptions for Small Projects. There are limited exemptions for installation, alteration, demolition, or repair work done on projects of $25,000 or less. The Contractor shall still comply with Labor Code sections 1720 et. seq. The only recognized exemptions are listed below:

1.12.1. Registration. The Contractor will not be required to register with the DIR for small projects. (Labor Code section 1771.1).

1.12.2. Certified Payroll Records. The records required in Labor Code section 1776 shall be required to be kept and submitted to the City of San Diego, but will not be required to be submitted online with the DIR directly. The Contractor will need to keep those records for at least three years following the completion of the Contract. (Labor Code section 1771.4).

1.12.3. List of all Subcontractors. The Contractor shall not be required to hire only registered subcontractors and is exempt from submitting the list of all subcontractors that is required in section 1.11. above. (Labor code section 1773.3).

ATTACHMENT E

SUPPLEMENTARY SPECIAL PROVISIONS

SUPPLEMENTARY SPECIAL PROVISIONS

The following Supplementary Special Provisions (SSP) modifies the following documents:

1. The **2021 Edition** of the Standard Specifications for Public Works Construction (The "GREENBOOK").

2. The **2021 Edition** of the City of San Diego Standard Specifications for Public Works Construction (The "WHITEBOOK"), including the following:

   a) General Provisions (A) for all Construction Contracts.

SECTION 1 – GENERAL, TERMS, DEFINITIONS, ABBREVIATIONS, UNITS OF MEASURE, AND SYMBOLS

1-2 TERMS AND DEFINITIONS. To the "WHITEBOOK":

To item 47, "Holiday", ADD the following:

Holiday	Observed On
Juneteenth	June 19

To the "WHITEBOOK", item 55, "Normal Working Hours", DELETE in its entirety and SUBSTITUTE with the following:

Normal Working Hours - Normal Working Hours shall be **6:00 AM – 3:00 PM**, Monday through Friday, inclusive. Saturdays, Sundays, and City Holidays are excluded. Unless otherwise specified on the Traffic Control Permits.

SECTION 3 – CONTROL OF THE WORK

3-2 SELF-PERFORMANCE. To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. You shall perform, with your own organization, Contract Work amounting to at least **30%** of the Base Bid.

SECTION 4 - CONTROL OF MATERIALS

4-6 TRADE NAMES. To the "WHITEBOOK", ADD the following:

11. You shall submit your list of proposed substitutions for an "equal" item **no later than 5 Working Days after the issuance of the Notice of Intent to Award** and on the City's Product Submittal Form available at:

    https://www.sandiego.gov/ecp/edocref/

SECTION 5 – LEGAL RELATIONS AND RESPONSIBILITIES

5-4 **INSURANCE.** To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

5-4 INSURANCE.

1. The insurance provisions herein shall not be construed to limit your indemnity and defense duties set forth in the Contract.

5-4.1 Policies and Procedures.

1. You shall procure the insurance described below, at your sole cost and expense, to provide coverage against claims for loss including injuries to persons or damage to property, which may arise out of or in connection with the performance of the Work by you, your agents, representatives, officers, employees or Subcontractors.

2. Insurance coverage for property damage resulting from your operations is on a replacement cost valuation. The market value will not be accepted.

3. You shall maintain this insurance as required by this Contract and at all times thereafter when you are correcting, removing, or replacing Work in accordance with this Contract. Your duties under the Contract, including your indemnity obligations, are not limited to the insurance coverage required by this Contract.

4. If you maintain broader coverage or higher limits than the minimums shown below, City requires and shall be entitled to the broader coverage or the higher limits maintained by you. Any available insurance proceeds in excess of the specified minimum limits of insurance and coverage shall be available to City.

5. Your payment for insurance shall be included in the Contract Price you bid. You are not entitled to any additional payment from the City to cover your insurance, unless the City specifically agrees to payment in writing. Do not begin any Work under this Contract or allow any Subcontractors to begin work, until you have provided, and the City has approved, all required insurance.

6. Policies of insurance shall provide that the City is entitled to 30 days advance written notice of cancellation or non-renewal of the policy or 10 days advance written notice for cancellation due to non-payment of premium. Maintenance of specified insurance coverage is a material element of the Contract. Your failure to maintain or renew coverage and to provide evidence of renewal during the term of the Contract may be treated by the City as a material breach of the Contract.

5-4.2 Types of Insurance.

5-4.2.1 General Liability Insurance.

1. Commercial General Liability Insurance shall be written on the current version of the ISO Occurrence form CG 00 01 07 98 or an equivalent form providing coverage at least as broad.
2. The policy shall cover liability arising from premises and operations, XCU (explosions, underground, and collapse), independent contractors, products/completed operations, personal injury and advertising injury, bodily injury, property damage, and liability assumed under an insured's contract (including the tort liability of another assumed in a business contract).
3. There shall be no endorsement or modification limiting the scope of coverage for either "insured vs. insured" claims or contractual liability. You shall maintain the same or equivalent insurance for at least 10 years following completion of the Work.
4. All costs of defense shall be outside the policy limits. Policy coverage shall be in liability limits of not less than the following:

General Annual Aggregate Limit	Limits of Liability
Other than Products/Completed Operations	$10,000,000
Products/Completed Operations Aggregate Limit	$10,000,000
Personal Injury Limit	$5,000,000
Each Occurrence	$5,000,000

5-4.2.2 Commercial Automobile Liability Insurance.

1. You shall provide a policy or policies of Commercial Automobile Liability Insurance written on the current version of the ISO form CA 00 01 12 90 or later version or equivalent form providing coverage at least as broad in the amount of $1,000,000 combined single limit per accident, covering bodily injury and property damage for owned, non-owned, and hired automobiles ("Any Auto").
2. All costs of defense shall be outside the limits of the policy.

5-4.2.3 Workers' Compensation Insurance and Employers Liability Insurance.

1. In accordance with the provisions of California Labor Code section 3700, you shall provide, at your expense, Workers' Compensation Insurance and Employers Liability Insurance to protect you against all claims under applicable state workers' compensation laws. The City, its elected officials, and employees will not be responsible for any claims in law or equity occasioned by your failure to comply with this requirement.

2. Statutory Limits shall be provided for Workers' Compensation Insurance as required by the state of California, and Employer's Liability Insurance with limits of no less than $1,000,000 per accident for bodily injury or disease.

3. By signing and returning the Contract, you certify that you are aware of the provisions of California's Workers' Compensation laws, including Labor Code section 3700, which requires every employer to be insured against liability for workers' compensation or to undertake self-insurance, and that you will comply with these provisions before commencing the Work.

5-4.3 **Rating Requirements.** Except for the State Compensation Insurance Fund, all insurance required by this Contract shall be carried only by responsible insurance companies with a rating of, or equivalent to, at least "A-, VI" by A.M. Best Company, that are authorized by the California Insurance Commissioner to do business in the state of California, and that have been approved by the City.

5-4.3.1 **Non-Admitted Carriers.** The City will accept insurance provided by non-admitted, "surplus lines" carriers only if the carrier is authorized to do business in the state of California and is included on the List of Approved Surplus Lines Insurers (LASLI list).

All policies of insurance carried by non-admitted carriers shall be subject to all of the requirements for policies of insurance provided by admitted carriers described in this Contract.

5-4.4 **Evidence of Insurance.** You shall furnish the City with original Certificates of Insurance, including all required amendatory endorsements (or copies of the applicable policy language effecting coverage required by this clause), prior to your commencement of Work under this Contract. In addition, The City reserves the right to require complete, certified copies of all required insurance policies, including endorsements, required by these specifications, at any time.

5-4.5 **Policy Endorsements.**

5-4.5.1 **Commercial General Liability Insurance.**

5-4.5.1.1 **Additional Insured.** To the fullest extent permitted by law and consistent with the limiting provisions set forth at California Civil Code section 2782, California Insurance Code section 11580.04, and any applicable successor statutes limiting indemnification of public agencies that bind the City, the policy or policies shall be endorsed to include as an Additional Insured the City and its respective elected officials, officers, employees, agents, and representatives, with respect to liability arising out of:

i. Ongoing operations performed by you or on your behalf,

ii. your products,

iii. your work, e.g., your completed operations performed by you or on your behalf, or

iv. premises owned, leased, controlled, or used by you.

5-4.5.1.2 **Primary and Non-Contributory Coverage.** The policy shall be endorsed to provide that the coverage with respect to operations, including the completed operations, if appropriate, of the Named Insured is primary to any insurance or self-insurance of the City and its elected officials, officers, employees, agents and representatives. Further, it shall provide that any insurance maintained by the City and its elected officials, officers, employees, agents and representatives shall be in excess of your insurance and shall not contribute to it.

5-4.5.1.3 **Project General Aggregate Limit.** The policy or policies shall be endorsed to provide a Designated Construction Project General Aggregate Limit that will apply only to the Work. Only claims payments which arise from the Work shall reduce the Designated Construction Project General Aggregate Limit. The Designated Construction Project General Aggregate Limit shall be in addition to the aggregate limit provided for the products-completed operations hazard.

5-4.5.2 **Workers' Compensation Insurance and Employers Liability Insurance.**

5-4.5.2.1 **Waiver of Subrogation.** The policy or policies shall be endorsed to provide that the insurer will waive all rights of subrogation against the City and its respective elected officials, officers, employees, agents, and representatives for losses paid under the terms of the policy or policies and which arise from Work performed by the Named Insured for the City.

5-4.6 **Deductibles and Self-Insured Retentions.** You shall disclose deductibles and self-insured retentions to the City at the time the evidence of insurance is provided. The City may require you to purchase coverage with a lower retention or provide proof of ability to pay losses and related investigations, claim administration, and defense expenses within the retention. The policy language shall provide, or be endorsed to provide, that the self-insured retention may be satisfied by either the named insured or City.

5-4.7 **Reservation of Rights.** The City reserves the right, from time to time, to review your insurance coverage, limits, deductibles, and self-insured retentions to determine if they are acceptable to the City. The City will reimburse you, without overhead, profit, or any other markup, for the cost of additional premium for any coverage requested by the Engineer, but not required by this Contract.

5-4.8 **Notice of Changes to Insurance.** You shall notify the City, in writing, 30 days prior to any material change to the policies of insurance provided under this Contract. This written notice is in addition to the requirements of paragraph 6 of Section 5-4.1.

5-4.9 **Excess Insurance.** Policies providing excess coverage shall follow the form of the primary policy or policies, including, all endorsements.

SECTION 6 – PROSECUTION AND PROGRESS OF THE WORK

6-1.1 Construction Schedule. To the "WHITEBOOK", ADD the following:

3. Refer to the Sample City Invoice materials in **Appendix D – Sample City Invoice with Cash Flow Forecast** and use the format shown.

ADD:

6-6.1.1 Environmental Document.

1. The City of San Diego has prepared a **Notice of Exemption** for **MBC Gas Detection System Replacement** (**"Metro Biosolids Center Gas Detection System Replacement"**), WBS No. **B-20121.02.06**, as referenced in the Contract Appendix. You shall comply with all requirements of the **Notice of Exemption** as set forth in **Appendix A.**

2. Compliance with the City's environmental document shall be included in the Contract Price, unless separate bid items have been provided.

SECTION 7 – MEASUREMENT AND PAYMENT

7-3.1 General. To the "WHITEBOOK", ADD the following:

4. The Lump Sum Bid item for "**Irrigation Repair**", shall include all materials and labor needed for irrigation repairs as specified in the Plans on E-2, and Contract Documents.

5. The Each Bid item for **"Removal of existing Gas sensors and Conductors",** shall include the removal of all existing gas sensors, and removal of existing conductors from I/O cabinets to Gas Sensors as specified in the Plans, Contract Documents, and Technical Specifications.

6. The Lump Sum Bid item for **"Demolition - Area 51"** shall include field investigation for Area 51 prior to demolition, the demolition of equipment in panel 51-AC-2110.LCP and related power conductors, and disconnecting, neatly coiling, labeling, storing DCS wiring and alarm horn beacon wiring, etc. in Area 51 as specified in the Plans, Contract Documents, and Technical Specifications. This Bid item includes payment for all demolition, removal, and preparation work apart from Bid item 7.

7. The Lump Sum Bid item for **"Demolition – Area 60"** shall include field investigation for Area 60 prior to demolition, the demolition of panel 60-AC-2500.LCP and related power conductors, and disconnecting, neatly coiling, labeling, and storing DCS wiring and alarm horn beacon wiring in Area 60 as specified in the Plans, Contract Documents, and Technical Specifications. This Bid item includes payment for all demolition, removal, and preparation work apart from Bid item 7.

8. The Lump Sum Bid item for **"Demolition - Area 70"** shall include field investigation for Area 70 prior to demolition the demolition of panel

70-AC-2100.LCP and related power conductors, and disconnecting, neatly coiling, labeling, and storing DCS wiring and alarm horn beacon wiring in Area 70 as specified in the Plans, Contract Documents, and Technical Specifications. This Bid item includes payment for all demolition, removal, and preparation work apart from Bid item 7.

9. The Lump Sum Bid item for **"Demolition - Area 73"** shall include field investigation for Area 73 prior to demolition as specified in the Plans, Contract Documents, and Technical Specifications. This Bid item includes payment for all demolition, removal, and preparation work apart from Bid item 7.

10. The Lump Sum Bid item for **"Demolition - Area 76"** shall include field investigation for Area 76 prior to demolition, the demolition of panel 76-AC-2350.LCP and related power conductors, demolition of equipment in panel 76-AC-2355.LCP and related conductors, and disconnecting, neatly coiling, labeling, and storing DCS wiring and alarm horn beacon wiring in Area 76 as specified in the Plans, Contract Documents, and Technical Specifications. This Bid item includes payment for all demolition, removal, and preparation work apart from Bid item 7.

11. The Lump Sum Bid item for **"Demolition - Area 80"** shall include field investigation for Area 80 prior to demolition, the demolition of panel 80-AC-2500.LCP and related power conductors, and disconnecting, neatly coiling, labeling, and storing DCS wiring and alarm horn beacon wiring in Area 80 as specified in the Plans, Contract Documents, and Technical Specifications. This Bid item includes payment for all demolition, removal, and preparation work apart from Bid item 7.

12. The Lump Sum Bid item for **"Demolition - Area 86"** shall include field investigation for Area 86 prior to demolition, the demolition of panel 86-AC-2355.LCP and related power conductors, demolition of panel 86-AC-2350.LCP and related power conductors, and disconnecting, neatly coiling, labeling, and storing DCS wiring and alarm horn beacon wiring in Area 86 as specified in the Plans, Contract Documents, and Technical Specifications. This Bid item includes payment for all demolition, removal, and preparation work apart from Bid item 7.

13. The Lump Sum Bid item for **"Demolition - Area 94"** shall include field investigation for Area 94 prior to demolition, the demolition of panel 94-AC-2124.LCP and related power conductors, and disconnecting, neatly coiling, labeling, and storing DCS wiring and alarm horn beacon wiring in Area 94 as specified in the Plans, Contract Documents, and Technical Specifications. This Bid item includes payment for all demolition, removal, and preparation work apart from Bid item 7.

14. The Lump Sum Bid item for **"Electrical Raceways, Boxes, and Conductors - Area 51"** shall include furnishing and installation of all electrical equipment,

conductors, conduits, panels, junction boxes, racks, mandrel and cleaning existing conduits, etc. in Area 51 as specified in the Plans, Contract Documents, and Technical specifications.

15. The Lump Sum Bid item for **"Electrical Raceways, Boxes, and Conductors - Area 60"** shall include furnishing and installation of all electrical equipment, conductors, conduits, panels, junction boxes, racks, mandrel and cleaning existing conduits, etc. in Area 60 as specified in the Plans, Contract Documents, and Technical specifications.

16. The Lump Sum Bid item for **"Electrical Raceways, Boxes, and Conductors - Area 70"** shall include furnishing and installation of all electrical equipment, conductors, conduits, panels, junction boxes, racks, mandrel and cleaning existing conduits, etc. in Area 70 as specified in the Plans, Contract Documents, and Technical specifications.

17. The Lump Sum Bid item for **"Electrical Raceways, Boxes, and Conductors - Area 73"** shall include furnishing and installation of all electrical equipment, conductors, conduits, panels, junction boxes, racks, mandrel and cleaning existing conduits, etc. in Area 73 as specified in the Plans, Contract Documents, and Technical specifications.

18. The Lump Sum Bid item for **"Electrical Raceways, Boxes, and Conductors - Area 76"** shall include furnishing and installation of all electrical equipment, conductors, conduits, panels, junction boxes, racks, mandrel and cleaning existing conduits, etc. in Area 76 as specified in the Plans, Contract Documents, and Technical specifications.

19. The Lump Sum Bid item for **"Electrical Raceways, Boxes, and Conductors - Area 80"** shall include furnishing and installation of all electrical equipment, conductors, conduits, panels, junction boxes, racks, mandrel and cleaning existing conduits, etc. in Area 80 as specified in the Plans, Contract Documents, and Technical specifications.

20. The Lump Sum Bid item for **"Electrical Raceways, Boxes, and Conductors - Area 86"** shall include furnishing and installation of all electrical equipment, conductors, conduits, panels, junction boxes, racks, mandrel and cleaning existing conduits, etc. in Area 86 as specified in the Plans, Contract Documents, and Technical specifications.

21. The Lump Sum Bid item for **"Electrical Raceways, Boxes, and Conductors - Area 94"** shall include furnishing and installation of all electrical equipment, conductors, conduits, panels, junction boxes, racks, mandrel and cleaning existing conduits, etc. in Area 94 as specified in the Plans, Contract Documents, and Technical specifications.

22. The Lump Sum Bid item for **"Electrical Raceways, Boxes, and Conductors - Area 19"** shall include furnishing and installation of all electrical equipment,

conductors, conduits, panels, junction boxes, racks, mandrel and cleaning existing conduits, etc. in Area 19 as specified in the Plans, Contract Documents, and Technical specifications.

23. The Each Bid item for **"Point Type Gas Sensor"** shall include furnishing and installation of the gas sensors as specified in the Plans, Contract Documents, and Technical specifications.

24. The Each Bid item for **"Single Point Sample Type Gas Detection Panel, One Sensor"** shall include furnishing and installation of the single point sample type gas detection panels with one sensor, air tubing, and all necessary appurtenances and supports as specified in the Plans, Contract Documents, and Technical specifications.

25. The Each Bid item for **"Single Point Sample Type Gas Detection Panel, Two Sensor"** shall include furnishing and installation of the single point sample type gas detection panels with two sensors, air tubing, and all necessary appurtenances and supports as specified in the Plans, Contract Documents, and Technical specifications.

26. The Each Bid item for **"Open Path Type Gas Sensor"** shall include furnishing and installation of the open path type gas sensors, poles, and pole foundations as specified in the Plans, Contract Documents, and Technical specifications.

27. The Lump Sum Bid item for "**Instrumentation and Controls - Area 51**" shall include the repair and refurbishment of existing 51-AC-2110.LCP's enclosure, furnishing and installing equipment in 51-AC.2110.LCP, re-terminating existing DCS wiring, coordination with the City to integrate new I/O, and preparation of loop diagrams in Area 51 as specified in the Plans, Contract Documents, and Technical Specifications. Sensors not included under this bid item.

28. The Lump Sum Bid item for "**Instrumentation and Controls - Area 60**" shall include furnishing and installation of panel 60-AC-2500.LCP, re-terminating existing DCS wiring, coordination with the City to integrate new I/O, and preparation of loop diagrams in Area 60 as specified in the Plans, Contract Documents, and Technical Specifications. Sensors not included under this bid item.

29. The Lump Sum Bid item for "**Instrumentation and Controls - Area 70**" shall include furnishing and installation of panel 70-AC-2100.LCP, re-terminating existing DCS wiring, coordination with the City to integrate new I/O, and preparation of loop diagrams in Area 70 as specified in the Plans, Contract Documents, and Technical Specifications. Sensors not included under this bid item.

30. The Lump Sum Bid item for "**Instrumentation and Controls - Area 73**" shall include re-terminating existing DCS wiring, coordination with the City to integrate new I/O, and preparation of loop diagrams in Area 73 as specified in the Plans, Contract Documents, and Technical Specifications. Sensors not included under this bid item.

31. The Lump Sum Bid item for "**Instrumentation and Controls - Area 76**" shall include furnishing and installation equipment in panel 76-AC-2355.LCP, furnishing and installation of panel 76-AC-2350.LCP, re-terminating existing DCS wiring, coordination with the City to integrate new I/O, and preparation of loop diagrams in Area 76 as specified in the Plans, Contract Documents, and Technical Specifications. Sensors not included under this bid item.

32. The Lump Sum Bid item for "**Instrumentation and Controls - Area 80**" shall include furnishing and installation of panel 80-AC-2500.LCP, re-terminating existing DCS wiring, coordination with the City to integrate new I/O, and preparation of loop diagrams in Area 80 as specified in the Plans, Contract Documents, and Technical Specifications. Sensors not included under this bid item.

33. The Lump Sum Bid item for "**Instrumentation and Controls - Area 86**" shall include furnishing and installation of panels 86-AC-2350.LCP and 86-AC-2355.LCP, re-terminating existing DCS wiring, coordination with the City to integrate new I/O, and preparation of loop diagrams in Area 86 as specified in the Plans, Contract Documents, and Technical Specifications. Sensors not included under this bid item.

34. The Lump Sum Bid item for "**Instrumentation and Controls - Area 94**" shall include furnishing and installation of panel 94-AC-2124.LCP, re-terminating existing DCS wiring, coordination with the City to integrate new I/O, and preparation of loop diagrams in Area 94 as specified in the Plans, Contract Documents, and Technical Specifications. Sensors not included under this bid item.

35. The Lump Sum Bid item for "**Instrumentation and Controls - Area 19**" shall include the coordination with the City to integrate new I/O and preparation of loop diagrams in Area 19 as specified in the Plans, Contract Documents, and Technical Specifications. Sensors not included under this bid item.

36. The Lump Sum Bid item for "**Start up and Commissioning**" shall include start up, testing, integration and commissioning for Electrical Systems and Instrumentation and Control Systems as specified in the Plans, Contract Documents, and Technical Specifications.

7-3.11 Compensation Adjustments for Price Index Fluctuations. To the "WHITEBOOK", ADD the following:

5. This Contract **is not** subject to the provisions of The "WHITEBOOK" for Compensation Adjustments for Price Index Fluctuations for paving asphalt.

SECTION 1001 – CONSTRUCTION BEST MANAGEMENT PRACTICES (BMPs)

1001-1 GENERAL. To the "WHITEBOOK", ADD the following:

8. Based on a preliminary assessment by the City, this Contract is subject to **Minor WPCP**.

TECHNICALS

CITY OF SAN DIEGO

Metropolitan Biosolids Center

MBC GAS DETECTION SYSTEM REPLACEMENT

WBS B20121

VOLUME 1
SPECIFICATIONS

February 2023

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Table of Contents

DIVISION 40 - PROCESS INTEGRATION

DIVISIONS 41 THROUGH 48 – NOT USED

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, incidentals and services as indicated in accordance with provisions of Contract Documents and required to comply with restrictions on Contractor's use of the site and other areas.
2. It is the intent of the Contract Documents to describe a functionally complete project. Furnish and install all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, complete, and functional installation.

1.02 WORK COVERED BY CONTRACT

A. The following list provides a general summary of the Work to be performed under this Contract. The list is not inclusive of all work required by the Contract Documents. The Contractor shall provide the work as established in the Contract Documents. The Work of this Contract under the Base Bid generally includes the following:

1. Mobilization: Work includes construction of office trailers, temporary sheds, temporary utilities, temporary facilities and all preparatory work necessary to the commencement of productive work at the site required under this contract.
2. Trenching Safety Measures, Sheeting, Shoring and Bracing: Work includes all planning and design to construct and place into operation all temporary sheeting and shoring, and removal and disposal of sheeting and shoring as required under the provisions of any permits, and in accordance with the requirements of OSHA and the Construction Safety Orders of the State of California, pursuant to the provisions of Section 6707 of the California Labor Code.
3. Site Preparation: Work in this area includes site preparations necessary for all demolition, excavation, backfill, compaction, trenching, and installation for the project site.
4. Demolition: Work includes the demolition including, but not limited to, existing gas monitoring panels, gas sensors, and conduit and conductors noted on the Drawings.
5. Electrical and Instrumentation: Work includes the gas sensors, gas monitoring panels, conduit, and conductors as shown on the Drawings.
6. DCS Integration: Work includes integrating new gas monitoring system with existing DCS and providing updated loop drawings. Included is any coordination required with the Owner regarding the existing DCS.

7. Startup Testing: Work includes the startup testing as required by the Contract Documents.
8. Operation & Maintenance Manuals: Work includes preparation of operation and maintenance manuals as required by the Contract Documents.
9. Final Record Drawings: Work includes preparation of final record drawings.

1.03 WORK SEQUENCE

A. Organize and plan the construction activities as described in Section 01 12 16 (Work Sequence) to assure the safety and reliability of and to minimize the interruption to the electric system and all other utilities.

B. The proposed Work sequence shall be submitted to the Engineer in the Schedule of Construction per contract specifications.

1.04 OWNER OCCUPANCY

A. Owner will occupy the premises during the entire period of construction for the conduct of his normal operations. Coordinate with Owner in all construction operations to minimize conflicts and to facilitate Owner usage.

B. Limit use of premises at the Site to work areas shown or indicated on the Drawings. Do not disturb portions of the Site beyond areas of the Work.

1.05 OUTAGES

A. Organize and plan the construction activities so that the number and length of any required outages shall be minimized.

B. The Owner reserves the right to reject any request for an outage.

C. In some cases it may be necessary, at Contractor's expense, to either install temporary facilities for service or schedule the Work during a period when the outage would have minimal impact on the Owner.

D. Provide the Owner at least ten (10) working days notice in advance of any requested outage so that the Owner may advise and coordinate the outage as needed.

1.06 CONTRACTOR-FURNISHED PRODUCTS

A. Furnish all products.

B. Components required to be supplied in quantity within a specification section shall all be the same and shall be interchangeable.

C. Unless otherwise indicated in the Contract Documents, provide materials and equipment that:

1. Is produced by reputable manufacturers having adequate experience in the manufacture of these items; and
2. Is designed for the service intended; and
3. Have not been previously been incorporated into another project or facility; and
4. Have not changed ownership since their initial production or fabrication and shipment from the manufacturer's factory or facility; and
5. If stored since their manufacture or fabrication, have, while in storage, been properly maintained and serviced in accordance with the manufacturer's recommendations for long-term storage; submit documentation under the relevant technical section that such maintenance and service has been performed; and
6. Have not been subject to degradation or deterioration since manufacture; and
7. Are the current model(s) or type(s) furnished by the Supplier and only modified as necessary to comply with the design.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 11 20
JOB CONDITIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Job conditions.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.

1.02 PROJECT CONDITIONS

A. Prior to installation of material, equipment and other work, verify with subcontractors, material or equipment manufacturers, and installers that the substrate or surface to which those materials attach is acceptable for installation of those materials or equipment. (Substrate is defined as building surfaces to which materials or equipment is attached to i.e., floors, walls, ceilings, etc.).

B. Correct unacceptable substrate until acceptable for installation of equipment or materials. All associated costs shall be included in the CONTRACTOR's bid.

C. Maintaining Facility Operations:

1. Facility is currently operating.
2. Ensure construction activities do not interfere with Owner's operation of facility.
3. Coordinate shutdowns with Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 12 16
WORK SEQUENCE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Narrative description of key work items and suggested sequencing to achieve the goal of continuous use of the affected facilities except for specifically described shutdowns.

B. Related Sections:

1. Division 1 - General Requirements
2. Section 01 11 00 - Summary of Work
3. Section 01 75 00 - Checkout and Start-Up Procedures

1.02 CONTINUITY OF PLANT OPERATIONS

A. GENERAL

1. The existing facility is currently and continuously in service, and those functions shall not be interrupted except as specified herein.
2. The CONTRACTOR shall coordinate the Work to avoid any interference with normal operation of plant equipment and processes.
3. The CONTRACTOR shall provide access for deliveries at all times.

1.03 SUBMITTALS

A. In accordance with Division 01, General Requirements, the CONTRACTOR shall submit a detailed outage plan and time schedule for operations to the OWNER for review and approval that will make it necessary to remove an electrical circuit, equipment or structure from service. The schedule shall be coordinated with the construction schedule specified in Division 01, General Requirements and shall meet the restrictions and conditions specified in this section. The detailed plan shall describe the CONTRACTOR's method for the length of time required to complete said operation and the means of temporary power which the CONTRACTOR shall provide.

B. The CONTRACTOR shall observe the following restrictions:

1. Systems or individual equipment items shall be isolated, decommissioned, de-energized, or depressurized in accordance with the approved detailed outage plan and schedule. The ENGINEER shall be notified in writing at least ten (10) working days in advance of the planned operation.
2. It is essential that the CONTRACTOR carefully coordinate proposed work with the OWNER before effecting unit shutdowns and under no circumstances will the CONTRACTOR be permitted to cease work at

the end of a normal working day if its actions have inadvertently caused a cessation of any plant operating process. If the latter factor is involved, CONTRACTOR's personnel shall remain on site until necessary repairs are completed.

3. CONTRACTOR shall not close any lines, open valves, or take any other action that would affect the operation of existing systems. Modification or operation of existing systems will be performed by OWNER operations staff only. Such actions will be considered by OWNER upon 7 days written notice.

C. The CONTRACTOR shall submit a written request for deactivation at least ten (10) working days prior to any work activity requiring removal of an electrical circuit, equipment, or structure from service.

1.04 WORK SEQUENCE

A. Construct the Work in stages to allow the OWNER to maintain use of the facilities and receive deliveries. The CONTRACTOR shall coordinate all critical work elements with the OWNER.

B. Requests for power outages of OWNER’s facilities shall be per Section 01 11 00 (Summary of Work).

C. The CONTRACTOR shall schedule and coordinate its operations, shall make all necessary temporary connections, and shall perform any other work necessary to ensure continuous plant operation.

D. The CONTRACTOR shall work continuously without interruption during critical connections and changeovers, or during any period requiring temporary utilities, as required to prevent interruption of facility operations. All associated over-time charges are to be part of the bid contract amount.

E. Any existing plant equipment, facilities, appurtenances, and utilities such as water lines, gas lines, electrical cables, communication lines, sludge lines, structures, vehicles, landscaping, etc., that are damaged by the CONTRACTOR during construction, even though inadvertently, shall be repaired immediately by CONTRACTOR at its own expense. Upon completion of the Work, restore premises to specified condition; if condition is not specified, restore to pre-construction condition.

1.05 SEQUENCE OF CONSTRUCTION:

A. General work sequences for the construction of major work elements are described below. The sequences are intended to achieve the goal of continuous use of the affected facilities except for specifically described shutdowns. Work elements are generally shown in sequence but are not necessarily on a critical path and may be done simultaneously unless noted otherwise. Work elements shown are not necessarily complete and others will be necessary as the work proceeds. The CONTRACTOR shall submit a

detailed work sequence schedule per General Requirements, including all proposed shutdowns, to accomplish the work.

B. All plant facilities are to be considered operational at all times unless specifically designated for shutdown in the following sequences. No shutdown of facilities will occur without written prior notice and approval by the OWNER, and demonstration to the OWNER that all equipment, materials, and supplies necessary to complete the work requiring the shutdown are on site and operable. Provide temporary power as needed.

C. All activities shall be performed by the CONTRACTOR as part of an approved work sequence schedule. Completion of installation of equipment shall include all electrical and control systems, and startup activities.

D. Early Construction Activities:

1. Potholing and field verification of existing above and below grade utilities, structures, valves, vaults, and junction boxes.
2. Field verification of existing conduits shown as homeruns on the Drawings. Identify existing conduits that will be reused.
3. Field verification of sample points shown on the Drawings. Notify the Engineer immediately if conflicts are found.
4. Site preparation.

E. Main Construction Activities:

1. Demolition:
   a. Removal of existing gas sensors, gas monitoring panels, conduit, and conductors.
   b. Rehabilitation of 51-AC-2100.LCP and 76-AC-2355.LCP enclosures.
2. Installation:
   a. Install gas sensors, gas monitoring panels, conduit, conductors, sample air tubing, and supports.
   b. Tie-in into existing panel boards.
   c. Coordinate with Owner to identify existing wires to DCS that will be reused for new gas monitoring panels.

F. Facility Start-up Sequences:

1. The following paragraphs outline the general startup sequences associated with the major processes. CONTRACTOR shall also refer to and implement the equipment manufacturers' specific requirements for start-up, as well as the commissioning requirements established within Section 01 75 00 and the individual equipment specifications.
   a. Gas monitoring panels
      1) Factory Testing: See Section 40 67 00 (Control System Equipment Panels and Racks) and 40 90 00 (Instrumentation and Control for Process System).
      2) Component Acceptance Test (CAT): See Section 40 90 00 (Instrumentation and Control for Process System).
      3) Site Acceptance Test (SAT): See Section 40 90 00 (Instrumentation and Control for Process System).

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 04
OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Administration of the submittal process for Operation and Maintenance Manuals.
2. Content requirements for Operation and Maintenance Manuals.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.
2. General submittal requirements are specified in the Contract Specifications.
3. Technical Specification Sections identifying required Operation and Maintenance Manual submittals.

1.02 DEFINITIONS

A. Equipment Operation and Maintenance Manuals:

1. Contain the technical information required for proper installation, operation and maintenance of process, electrical and mechanical equipment and systems.

1.03 SUBMITTALS

A. List of all the Operation and Maintenance Manuals required by the Contract as identified in the Technical Specification Sections. These may be referred to as "Operation and Maintenance Data" submittals.

B. Operation and Maintenance Manuals:

1. Draft and final electronic copies.
2. Final paper copies: One (1).

1.04 SUBMITTAL SCHEDULE

A. List of Required Operation and Maintenance Manuals:

1. Submit list with Specification Section number and title within 90 days after Notice to Proceed.

B. Draft Operation and Maintenance Manuals:

1. Submit approvable draft manuals in electronic format (PDF) within 30 days following approval of the respective Shop Drawing.

a. Include placeholders or fly sheet pages where information is not final or is missing from the draft manual.

2. All Draft Operation and Maintenance Manuals shall be received by no later than 50 PCT project completion.

C. Final Operation and Maintenance Manuals:

1. Final approval of Operation and Maintenance Manuals in electronic format (PDF) must be obtained 45 days prior to equipment start-up.
2. Provide paper copies and CD-ROMs of approved final Operation and Maintenance Manuals in electronic format (PDF), a minimum of 30 days prior to equipment start-up.
3. Issue addenda to Final Approved Operation and Maintenance Manual to include:
   a. Equipment data that requires collection after start-up, for example but not limited to HVAC balancing reports, electrical switchgear, automatic transfer switch and circuit breaker settings.
   b. Equipment field testing data.
   c. Equipment start-up reports.

1.05 PREPARATION OF SUBMITTALS

A. General:

1. All pages of the Operation and Maintenance Manual submittal shall be legible.
   a. Submittals which, in the Engineer’s sole opinion, are illegible will be rejected without review.
2. Identify each equipment item in a manner consistent with names and identification numbers used in the Contract Documents, not the manufacturer’s catalog numbers.
3. Neatly type any data not furnished in printed form.
4. Operation and Maintenance Manuals are provided for Owner's use, to be reproduced and distributed as training and reference materials within Owner's organization.
   a. This requirement is:
      1) Applicable to both paper copy and electronic files.
      2) Applicable to materials containing copyright notice as well as those with no copyright notice.
5. Notify supplier and/or manufacturer of the intended use of Operations and Maintenance Manuals provided under the Contract.

D. Operation and Maintenance Manual Format and Delivery:

1. Draft electronic submittals:
   a. Provide manual in Adobe Acrobat Portable Document Format (PDF), latest version.
   b. Create one (1) PDF file for each equipment Operation and Maintenance Manual.
   c. Do not password protect or lock the PDF document.

d. Scanned images of paper documents are not acceptable. Create the Operation and Maintenance Manual PDF file from the original source document.
e. Drawings or other graphics must be converted to PDF file format from the original drawing file format and made part of the PDF document.
f. Scanning of drawings is to be used only where actual file conversion is not possible and drawings must be scanned at a resolution of 300 dpi or greater.
g. Rotate sheets that are normally viewed in landscape mode so that when the PDF file is opened the sheet is in the appropriate position for viewing.
h. Create bookmarks in the bookmarks panel for the Operation and Maintenance Manual cover, the Table of Contents and each major section of the Table of Contents.
i. Using Adobe Acrobat Standard or Adobe Acrobat Professional, set the PDF document properties, initial view as follows:
    1) Select File →Properties→Initial View.
    2) Select the Navigation tab: Bookmarks Panel and Page.
    3) Select the Page layout: Single Page Continuous.
    4) Select the Magnification: Fit Page.
    5) Select Open to page: 1.
    6) Set the file to open to the cover page of the manual with bookmarks to the left, and the first bookmark linked to the cover page.
    7) Window Options: Check the "Resize window to initial page" box.
j. Set the PDF file "Fast Web View" option to open the first several pages of the document while the rest of the document continues to load.
    1) To do this:
        a) Select Edit→Preferences→ Documents→Save Settings.
        b) Check the "Save As optimizes for Fast Web View" box.
k. PDF file naming convention:
    1) Use the Specification Section number, the manufacturer's name and the equipment description, separated by underscores.
    2) Example: 46 51 21_Sanitaire_Coarse_Bubble_Diffusers.pdf.
    3) Do not put spaces in the file name.

2. Final electronic submittals:
    a. Submit two (2) copies in PDF file format on two (2) CD-ROM discs (one (1) copy per CD-ROM), each secured in a jewel case.
    b. CD-ROM Labeling:

1) Provide the following printed labeling on all CD-ROM discs:
   a) Project name.
   b) Specification Section.
   c) Equipment names and summary of tag(s) covered.
   d) Manufacturer name.
   e) Date (month, year).

c. CD-ROM Jewel Case Holder:
   1) Insert jewel cases containing labeled CD-ROM discs in three-ring binder holder (C-Line Products, www.c-lineproducts.com stock number CLI-61968 or equivalent) at the front of each final paper copy.

3. Final paper copy submittals:
   a. Quantity: Provide two (2) copies.
   b. Paper: 8.5 x 11 IN or 11 x 17 IN bright white, 20 LB paper with standard three-hole punching.
   c. 3-Ring Binder:
      1) Provide D-ring binder with clear vinyl sleeves (i.e. view binder) on front and spine.
      2) Insert binder title sheet with the following information under the front and spine sleeves:
         a) Project name.
         b) Specification Section.
         c) Equipment names and summary of tag(s) covered.
         d) Manufacturer name.
         e) Date (month, year).
      3) Provide plastic sheet lifters prior to first page and following last page.
   d. Drawings:
      1) Provide all drawings at 11 x 17 IN size, triple folded and three-hole punched for insertion into manual.
      2) Where reduction is not practical to ensure readability, fold larger drawings separately and place in three-hole punched vinyl envelopes inserted into the binder.
      3) Identify vinyl envelopes with drawing numbers.
   e. Use plastic coated dividers to tab each section of each manual in accordance with the Table of Contents.

E. Equipment Operation and Maintenance Manual Content:

1. Provide a cover page as the first page of each manual with the following information:
   a. Manufacturer(s) Name and Contact Information.
   b. Vendor’s Name and Contact Information.
   c. Date (month, year).
   d. Project Owner and Project Name.
   e. Specification Section.

f. Project Equipment Tag Numbers.
g. Model Numbers.
h. Engineer's Name.
i. Contractor's Name.

2. Provide a Table of Contents for each manual.
3. Provide Equipment Record sheets as follows:
   a. Printed copies of the Equipment Record (Exhibits B1, B2 and B3), as the first tab following the Table of Contents.
   b. Exhibits B1-B3 are available as Fillable PDF Form documents from the Engineer.
   c. Each section of the Equipment Record must be completed in detail; simply referencing the related equipment Operation and Maintenance Manual sections for nameplate, maintenance, spare parts or lubricant information is not acceptable.
   d. For equipment involving separate components (for example, a motor and gearbox), a fully completed Equipment Record is required for each component.
   e. Submittals that do not include the Equipment Record(s) will be rejected without further content review.
4. Provide a printed copy of the Manufacturer's Field Services report as required by Specification Section 01 75 00 (Checkout and Start-Up Procedures) following the Equipment Record sheets.
5. Provide the following detailed information, as applicable:
   a. Use equipment tag numbers from the Contract Documents to identify equipment and system components.
   b. Equipment function, normal and limiting operating characteristics.
   c. Instructions for assembly, disassembly, installation, alignment, adjustment, and inspection.
   d. Operating instructions for start-up, normal operation, control, shutdown, and emergency conditions.
   e. Lubrication and maintenance instructions.
   f. Troubleshooting guide.
   g. Mark each sheet to clearly identify specific products and component parts and data applicable to the installation for the Project; delete or cross out information that does not specifically apply to the Project.
   h. Parts lists:
      1) A parts list and identification number of each component part of the equipment.
      2) Exploded view or plan and section views of the equipment with a detailed parts callout matching the parts list.
      3) A list of recommended spare parts.
      4) List of spare parts provided as specified in the associated Specification Section.
      5) A list of any special storage precautions which may be required for all spare parts.

i. General arrangement, cross-section, and assembly drawings.
j. Electrical diagrams, including elementary diagrams, wiring diagrams, connection diagrams, and interconnection diagrams.
k. Test data and performance curves.
l. As-constructed fabrication or layout drawings and wiring diagrams.
m. Copy of the equipment manufacturer's warranty meeting the requirements of the Contract.
n. Copy of any service contracts provided for the specific piece of equipment as part of the Contract.

6. Additional information as required in the associated equipment or system Specification Section.

F. Building Materials and Finishes Operation and Maintenance Manual Content:

1. Provide a cover page as the first page of each manual with the following information:
   a. Manufacturer(s) Name and Contact Information.
   b. Vendor's Name and Contact Information.
   c. Date (month, year).
   d. Project Owner and Project Name.
   e. Specification Section.
   f. Model Numbers.
   g. Engineer's Name.
   h. Contractor's Name.
2. Provide a Table of Contents for each manual.
3. Building products, applied materials and finishes:
   a. Include product data, with catalog number, size, composition and color and texture designations.
   b. Provide information for ordering custom manufactured products.
4. Necessary precautions:
   a. Include product MSDS for each approved product.
   b. Include any precautionary application and storage guidelines.
5. Instructions for care and maintenance:
   a. Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods and recommended schedule for cleaning and maintenance.
6. Moisture protection and weather exposed products:
   a. Include product data listing, applicable reference standards, chemical composition, and details of installation.
   b. Provide recommendations for inspections, maintenance and repair.
7. Additional requirements as specified in individual product specifications.

G. National Fire Protection Association 70 (National Electrical Code) Documentation:

1.06 TRANSMITTAL OF SUBMITTALS

A. Operation and Maintenance Manuals.

1. Transmit all submittals to:
   a. The address specified in the contract documents.

2. Transmittal form: Use Operation and Maintenance Manual Transmittal, Exhibit A.
3. Transmittal numbering:
   a. Number each submittal with the Specification Section number followed by a series number beginning with "-01 IN and increasing sequentially with each additional transmittal, followed by "-OM" (for example: 43 23 14-01-OM).
4. Submit draft and final Operation and Maintenance Manual in electronic format (PDF) to Engineer, until manual is approved.

1.07 ENGINEER'S REVIEW ACTION

A. Draft Electronic (PDF) Submittals:

1. Engineer will review and indicate one of the following review actions:
   a. A - ACCEPTABLE
   b. B - FURNISH AS NOTED
   c. C - REVISE AND RESUBMIT
   d. D - REJECTED
2. Submittals marked as Acceptable or Furnish As Noted will be retained; however, the transmittal form will be returned with a request for the final paper and electronic documents to be submitted.
3. Copies of submittals marked as Revise and Resubmit or Rejected will be returned with the transmittal form marked to indicate deficient areas.
4. Resubmit until approved.

B. Final Paper Copy Submittals:

1. Engineer will review and indicate one (1) of the following review actions:
   a. A - ACCEPTABLE
   b. D - REJECTED
2. Submittals marked as Acceptable will be retained with the transmittal form returned as noted.
3. Submittals marked as Rejected will be returned with the transmittal form marked to indicate deficient areas.
4. Resubmit until approved.

PART 2 PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

EXHIBIT A **Operation and Maintenance Manual Transmittal _____-_____ - OM**
(Spec Section) (Series)

Project Name: Date Received:

Project Owner: Checked By:

Contractor: Owner: Log Page:

Address: Address: HDR No.:

Attn: Attn:

1st. Sub. ReSub.

Date Transmitted: Previous Transmittal Date:

No. Copies	Description of Item	Manufacturer	Dwg. or Data No.	Action Taken*

Remarks:

To: From:

HDR Engineering, Inc.

Date:

* The Action designated above is in accordance with the following legend:

A - Acceptable, provide one (1) additional paper copy and two (2) electronic copies on CD-ROM for final review.

B - ~~Furnish as Noted~~ - Not Used

C - Revise and Resubmit
This Operation and Maintenance Manual Submittal is deficient in the following area:

1. Equipment Records.
2. Functional description.
3. Assembly, disassembly, installation, alignment, adjustment & checkout instructions.
4. Operating instructions.
5. Lubrication & maintenance instructions.
6. Troubleshooting guide.
7. Parts list and ordering instructions.
8. Organization (binder, binder titles, index & tabbing).
9. Wiring diagrams & schematics specific to installation.
10. Outline, cross section & assembly diagrams.
11. Test data & performance curves.
12. Tag or equipment identification numbers.
13. Inclusion of all components & subcomponents.
14. Other - see comments.

D - ~~Rejected~~ - Not Used

Comments:

By Date

Distribution: Contractor | File | Field | Owner | Other

EXHIBIT B1

Equipment Record

Equipment Data and Spare Parts Summary

Project Name	Specification Section:
Equipment Name	Year Installed:
Project Equipment Tag No(s).	
Equipment Manufacturer	Project/ Order No.
Address	Phone
Fax / Web Site / E-mail	
Local Vendor/Service Center	
Address	Phone
Fax / Web Site / E-mail	

MECHANICAL NAMEPLATE DATA

Equip.		Serial No.		
Make		Model No.		
ID No.	Frame No.	HP	RPM	Cap.
Size	TDH	Imp. Sz.	CFM	PSI
Other:				

ELECTRICAL NAMEPLATE DATA

Equip.				Serial No.				
Make				Model No.				
ID No.	Frame No.	HP	V.	Amp.	HZ	PH	RPM	SF
Duty	Code	Ins. Cl.	Type	NEMA	C Amb.	Temp. Rise	Rating	
Other:								

SPARE PARTS PROVIDED PER CONTRACT

Part No.	Part Name	Quantity

RECOMMENDED SPARE PARTS

Part No.	Part Name	Quantity

EXHIBIT B2

Equipment Record

Recommended Maintenance Summary

Equipment Description	Project Equip. Tag No(s).	

RECOMMENDED BREAK-IN MAINTENANCE (FIRST OIL CHANGES, ETC.)	INITIAL COMPLETION * FOLLOWING START-UP							
	D	W	M	Q	S	A	RT	Hours

RECOMMENDED PREVENTIVE MAINTENANCE	PM TASK INTERVAL *							
	D	W	M	Q	S	A	RT	Hours

*** D = Daily W = Weekly M = MonthlyQ = Quarterly S = Semiannual A = AnnualHours = Run Time Interval**

EXHIBIT B3

Equipment Record

Lubrication Summary

Equipment Description	Project Equip. Tag No(s).

Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					
Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					
Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					
Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					
Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					
Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

SECTION 01 73 20
OPENINGS AND PENETRATIONS IN CONSTRUCTION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Methods of installing and sealing openings and penetrations in construction.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. ASTM International (ASTM):
   a. A36, Standard Specification for Carbon Structural Steel.
   b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   c. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
   d. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
   e. A351, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
   f. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
   g. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   h. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   i. A995, Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts.
2. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC):
      1) Article 501, Class 1 Locations.
   b. 90A, Standard for Installation of Air Conditioning and Ventilating Systems.
   c. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1.03 DEFINITIONS

A. Corrosive Areas: See Drawings for area classification.

B. Hazardous Areas: Areas shown in the Contract Documents as having Class I or Class II area classifications.

C. Washdown Areas: Areas having floor drains or hose bibbs.

1.04 SUBMITTALS

A. Shop Drawings:

1. For each structure provide dimensioned or scaled (minimum 1/8 IN = 1 FT) plan view drawings containing the following information:
   a. Vertical and horizontal location of all required openings and penetrations.
   b. Size of all openings and penetrations.
   c. Opening type.
   d. Seal type.
2. Manufacturer's installation instructions for standard manufactured products.

PART 2 PRODUCTS (NOT USED)

2.01 MATERIALS

A. Pipe Sleeves:

1. Areas listed as Corrosive Areas in PART 1:
   a. Stainless steel, Type 304L.
   b. Penetrations 24 IN DIA or less: ASTM A269, ASTM A312 or ASTM A554, Schedule 40.
   c. Penetrations larger than 24 IN DIA: Stainless steel, ASTM A666, Minimum 1/4 IN thickness.
2. All other Areas:
   a. Steel, Hot-dipped galvanized after fabrication.
   b. Steel, painted.
   c. Penetrations 24 IN DIA or less: ASTM A53, Schedule 40.

PART 3 EXECUTION (NOT USED)

3.01 INSTALLATION AND APPLICATION

A. Perform electrical penetrations in accordance with NFPA 70, Article 501.

B. Where pipes, conduits or ducts pass through floors in washdown areas, install sleeves with top 3 IN above finish floors.

1. In non-washdown areas, install sleeves with ends flush with finished surfaces.

C. Size sleeves, blockouts and cutouts which will receive sealant seal such that free area to receive sealant is minimized and seal integrity may be obtained.

D. Where pipes, conduits or ducts pass through grating, provide banding at the entire perimeter of the opening.

E. Where pipes, conduits or ducts are removed where passing through grating:

1. Metal grating:
   a. Provide banding at perimeter and cover opening with 1/4 IN plate of the same material of the grating.
2. FRP grating:
   a. Provide full depth cover meeting same loading requirement as existing material or replace grating section.

F. Do not cut into or core drill any beams, joists, or columns.

G. Do not install sleeves in beams, joists, or columns.

H. Do not install recesses in beams, joists, columns, or slabs.

I. Field Cutting and Coring:

1. Saw or core drill with non-impact type equipment.
2. Mark opening and drill small 3/4 IN or less holes through structure following opening outline.
3. Sawcut opening outline on both surfaces.
   a. Knock out within sawcuts using impact type equipment.
   b. Do not chip or spall face of surface to remain intact.
   c. Do not allow any overcut with saw kerf.

J. Precast-Prestressed Concrete Construction:

1. Do not cut openings or core drill vertically or horizontally through stems of members.
2. Do not locate or install sleeves or recess sleeves vertically or horizontally through or in stems of members.
3. Cast openings and sleeves into flanges of units.
4. Cast openings larger than 6 IN in diameter or 6 IN maximum dimension in units at time of manufacture.
5. Cast openings smaller than 6 IN in diameter or 6 IN maximum dimensions in flanges of units at time of manufacture or field cut.

K. Where alterations are necessary or where new and old work join, restore adjacent surfaces to their condition existing prior to start of work.

L. Where area is blocked out to receive sheet metal sleeve at later date:

1. If blockout size is sufficient to allow placement, utilize dowels for interface of initially placed concrete and sleeve encasement concrete which is placed later.
   a. Size blockout based on sleeve size required plus 4 to 6 IN each side of sleeve for concrete encasement.
   b. Provide #4 dowels at 12 IN spacing along each side of blockout with minimum of two dowels required per side.
2. If blockout size is not sufficient to allow placement of dowels, provide keyway along all sides of blockout.

a. Size blockout based on sleeve size required plus 2 to 4 IN each side of sleeve for concrete encasement.

M. For interior wall applications where backer rod and sealant are specified, provide backer rod and sealant at each side of wall.

N. Use full depth expanding foam sealant for seal applications where single or multiple pipes, conduits, etc., pass through a single sleeve.

O. Do not make duct or conduit penetrations below high water levels when entering or leaving tankage, wet wells, or other water holding structures.

3.02 SCHEDULES

A. General Schedule of Penetrations through Floors, Roofs, Foundation Base Slabs, Foundation Walls, Foundation Footings, Partitions and Walls for Ductwork, Piping, and Conduit:

1. Provide the following opening and penetration types:
   a. Type A - Block out 2 IN larger than outside dimensions of duct, pipe, or conduits.
   b. Type B - Saw cut or line-drill opening. Place new concrete with integrally cast sheet metal or pipe sleeve.
   c. Type C - Fabricated sheet metal sleeve or pipe sleeve cast-in-place. Provide pipe sleeve with water ring for wet and/or washdown areas.
   d. Type D - Commercial type casting or fabrication.
   e. Type E - Saw cut or line-drill opening. Place new concrete with integrally cast pipe, duct or conduit spools.
   f. Type F - Integrally cast pipe, duct or conduit.
   g. Type G - Saw cut or line-drill and remove area 1 IN larger than outside dimensions of duct, pipe or conduit.
   h. Type H - Core drill.
   i. Type I - Block out area. At later date, place new concrete with integrally cast sheet metal or pipe sleeve.
   j. Type J - Grating Banding for any field cut openings.
2. Provide seals of material and method described as follows.
   a. Category 1 - Modular Mechanical Seal.
   b. Category 2 - Roof curb and flashing according to SMACNA specifications unless otherwise noted on Drawings.
   c. Category 3 - 12 GA sheet metal drip sleeve set in bed of silicon sealant with backing rod and sealant used in sleeve annulus.
   d. Category 4 - Backer rod and sealant.
   e. Category 5 - Full depth compressible sealant with escutcheons on both sides of opening.
   f. Category 6 - Full depth compressible sealant and flanges on both sides of opening. Flanges constructed of same material as duct, fastened to duct and minimum 1/2 IN larger than opening.

g. Category 7 - Full depth compressible sealant and finish sealant or full depth expanding foam sealant depending on application.
h. Category 8 - Banding for all grating openings and banding and cover plate of similar materials for abandoned openings.

3. Furnish openings and sealing materials through new floors, roofs, grating, partitions and walls in accordance with Schedule A, Openings and Penetrations for New Construction.
4. Furnish openings and sealing materials through existing floors, grating, roofs, partitions and walls in accordance with Schedule B, Openings and Penetrations for Existing Construction.

SCHEDULE A. OPENINGS AND PENETRATIONS SCHEDULE FOR NEW CONSTRUCTION

APPLICATIONS	DUCTS		PIPING		CONDUIT	
	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY
Through floors with bottom side a hazardous location	C F I	7 Not Req 7	D F I (1)	Not Req Not Req 7	C F	7 Not Req
Through floors on grade above water table	C F I	4 Not Req 4	C F I (1)	7 Not Req 7	C F I (1)	4 Not Req 7
Through slab on grade below water table	F	Not Req	F	Not Req	F	Not Req
Through floors in washdown areas	C I	4 4	C H (2) I (1)	4 3 4	F H (2) I (1)	Not Req 3 7
Through walls where one side is a hazardous area	C F I	7 Not Req 7	D F I (1)	Not Req Not Req 7	C F	7 Not Req
Through exterior wall below grade above water table	C F I	7 Not Req 7	C D F I (1)	1 Not Req Not Req 1	F I (1)	Not Req 7
Through wall from tankage or wet well (above high water level) to dry well or dry area	C F I	7 Not Req 7	C D F H (2)	1 Not Req Not Req 1	C F H (2) I (1)	7 Not Req 7 7
Through wall from tankage or wet well (below high water level) to dry well or dry area	F	Not Req	F	Not Req	F	Not Req
Through exterior wall above grade	A B C	6 6 6	A B D H (2)	5 5 Not Req 5	C H (2)	5 4
Roof penetrations	A	2	A	2	A	2
Through interior walls and slabs not covered by the above applications	A C	4 4	A C	4 4	A C F	4 4 Not Req
Grating openings and penetrations	J	8	J	8	J	8

SCHEDULE B. OPENINGS AND PENETRATIONS SCHEDULE FOR EXISTING CONSTRUCTION

APPLICATIONS	DUCTS		PIPING		CONDUIT	
	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY
Through floors with bottom side a hazardous location	B E	7 Not Req	B (1) E (3) H (2)	7 Not Req 7	B (1) E (3) H (2)	7 Not Req 7
Through floors on grade above water table	B	7	B	7	B	7
Through slab on grade below water table	E	Not Req	E	Not Req	E	Not Req
Through floors in washdown areas	G	3	G H (2)	3 3	G H (2)	3 3
Through walls where one side is a hazardous area	B E	7 Not Req	B (1) B (3) E H (2)	7 1 Not Req 7	B (1) (3) E H (2)	7 Not Req 7
Through exterior wall below grade above water table	B	7	B (1) B (3) H (2)	7 1 7	B (1) (3) H (2)	7 7
Through wall from tankage or wet well (above high water level) to dry well or dry area	B E	7 Not Req	B E H (2)	1 Not Req 1	B (1) (3) E H (2)	7 Not Req 7
Through wall from tankage or wet well (below high water level) to dry well or dry area	E	Not Req	E	Not Req	E	Not Req
Through exterior wall above grade	G	6	G (1) (3) H (2)	5 5	G (1) (3) H (2)	5 7
Roof penetrations	G	2	G (1) (3) H (2)	2	G	2
Through interior walls and slabs not covered by the above applications	G	4	G (1) (3) H (2)	4 4	G (1) (3) H (2)	4 4
Grating openings and penetrations	J	8	J	8	J	8

(1) Multiple piping 3 IN and smaller or multiple conduits.
(2) Single pipe 3 IN and smaller or single conduit.
(3) Single pipe or conduit larger than 3 IN.

END OF SECTION

END OF SECTION

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for cutting and patching Work.

B. Scope:

1. Contractor shall perform cutting and coring, and rough and finish patching of holes and openings in existing construction.
2. Provide cutting, coring, fitting, and patching, including attendant excavation and fill, required to complete the Work, and to:
   a. Remove and replace defective Work;
   b. Remove samples of installed Work as specified or required for testing;
   c. Remove construction required to perform required alterations or additions to existing construction;
   d. Uncover the Work for Engineer's observation of covered Work, testing, or inspection by testing entities, or observation by authorities having jurisdiction;
   e. Connect to completed Work not performed in proper sequence;
   f. Remove or relocate existing utilities and piping that obstruct the Work in locations where connections are to be made;
   g. Make connections or alterations to existing or new facilities.
   h. Cutting, coring, and rough patching shall be performed by the prime contractor requiring the opening. Finish patching shall be responsibility of General Contractor and shall be performed by Subcontractor or trade associated with application of the particular finish.

1.02 SUBMITTALS

A. Action Submittals: Submit the following:

1. Cutting and Patching Request:
   a. Submit written request to Engineer, well in advance of executing cutting or alteration that affects one or more of the following:
      1) Design function or intent of Project.
      2) Work of Owner or other contractors retained by Owner.
      3) Structural capacity or integrity of an element of the Project, building, or structure.
      4) Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.

5) Efficiency, operational life, maintenance, or safety of operational elements.
6) Visual qualities of elements that will be exposed to view after completion of the Work.

b. Request shall include:
1) Identification of Project and Contract designation.
2) Description of affected Work of Contractor and work of others (if any) retained by Owner.
3) Necessity for cutting.
4) Effect on work or operations of Owner and other contractors (if any) retained by Owner, and on structural and weatherproof integrity of Project, building, or structure.
5) Description of proposed Work, indicating scope of cutting and patching; trades that will execute the cutting and patching Work; materials and equipment to be used; extent of refinishing; schedule of operations; alternatives (if any) to cutting and patching, and net effect on aesthetics following completion of finishing Work.
6) Indication of entity responsible for cost of cutting and patching, when applicable.
7) Written permission of other prime contractors (if any) whose work will or may be affected.

2. Recommendation Regarding Cutting and Patching:
a. Should conditions of work or schedule indicate a change of materials or specified methods, furnish Submit written recommendation to Engineer including:
1) Conditions indicating change.
2) Recommendations for alternative materials or alternatives to specified methods.
3) Material manufacturer's printed recommendations for the proposed product and recommendations of manufacturer's technical representative for the specific application(s). The latter shall be on technical representative's letterhead and shall explicitly indicate the Project and specific cutting and patching application(s) to which the recommendation(s) apply.
4) Items required with request for approval of substitute, in accordance with the substitution request requirements of the Contract Documents.

3. Product Data:
a. Submit manufacturer's published data for the protective compound to be applied to core-drilled surfaces and cut concrete surfaces.
b. When not required under other Specifications sections, submit manufacturer's published data on materials to be used for finishing around the cut or patched area(s), together with indication of the location(s) where each is proposed for use.

c. Furnish Submittals for patching materials under the associated Specifications section. Submittal to include letter of recommendation from product manufacturer's technical representative indicating on technical representative's letterhead, explicitly indicating:
   1) Project name and facility name;
   2) Specific cutting and patching application(s) to which the recommendations apply;
   3) That product manufacturer's technical representative has personally observed and is familiar with conditions in the work area(s) of the subject cutting and patching;
   4) Materials that are the subject of the Submittal are appropriate for the condition(s) of the proposed patch and will remain durable in the patch's final exposure upon Substantial Completion; and.
   5) Patching material manufacturer's technical representative's recommendations for surface preparation, installation of patching material(s), and curing.

B. Informational Submittals: Submit the following:

1. Written Notification of Cutting and Patching:
   a. Furnish as a Submittal written indication designating the day and time that the construction associated with cutting and patching will be uncovered to allow for observation. Do not begin cutting or patching operations until submittal is accepted by Engineer.
2. X-ray Investigations:
   a. Proposed method of investigation. Submit and obtain Engineer's acceptance prior to performing x-ray inspections.
   b. Report of x-ray evaluation of slabs, floors, and walls to be cut or core-drilled.

PART 2 PRODUCTS (NOT USED)

2.01 MATERIALS

A. Materials – General:

1. Provide materials that comply with the Contract Documents.
2. If not shown or indicated in the Contract Documents, use materials identical to existing materials affected by cutting and patching Work.
3. For exposed surfaces, use materials that visually match existing adjacent surfaces to fullest extent possible. If identical materials are unavailable or cannot be used, provide materials whose installed performance will equal or surpass that of existing materials.
4. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using materials that do not void required or existing warranties.

B. Compound Applied to Core-Drilled Surfaces and Cut Concrete Surfaces:

1. After core-drilling or sawcutting (as applicable) and before installing the utility or equipment through the penetration, coat exposed concrete and exposed steel with solvent-free, two-component, protective, epoxy resin coating.
2. Color shall approximate the finish color of the existing surface to be coated.
3. Product and Manufacturer: Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
   a. Sikagard 62, by Sika Corporation.
   b. Or equal.

C. Grout Materials:

1. Sand Cement Grout (referred to as "Grout" on the Drawings):
   a. Approximately three parts sand, one part Portland cement, 6 ±1% entrained air and water to produce a slump which allows grout to completely fill required areas and surround adjacent reinforcing.
      1) Provide sand in accordance with requirements for fine aggregate for concrete.
   b. Minimum 28 day compressive strength:
      1) 3000 PSI.
      2) Shall be at least strength of parent concrete when used at construction joints.
2. Non-shrink Grout:
   a. Non-shrink, nonmetallic, noncorrosive, and nonstaining.
      1) Conform to ASTM C1107.
   b. Premixed with only water to be added in accordance with manufacturer's instructions at jobsite.
   c. Grout to produce a positive but controlled expansion.
      1) Mass expansion shall not be created by gas liberation or by other means.
   d. Minimum 28 day compressive strength: 7,000 PSI.
   e. Acceptable manufacturers:
      1) Master Builders Solutions "Masterflow, 713".
      2) Euclid Chemical "NS Grout".
      3) Sika Corporation "Sika Grout 212".
      4) Sauereisen, Inc. "F-100 Level Fill Grout".
      5) Or equal.
3. Epoxy Grout:
   a. Three-component epoxy resin system:
      1) Two liquid epoxy components.
      2) One inert aggregate filler component.
   b. Adhesive acceptable manufacturers:
      1) Master Builders Solutions “Masterflow 648".
      2) Five Start Products, Inc. "DP Five Start Epoxy Grout."
      3) Euclid Chemical "E3 Flowable."
      4) Sika "Sikadur Hi-Mod."
      5) Or equal.

c. Aggregate acceptable manufacturers:
   1) Master Builders Solutions “Masterflow 648".
   2) Five Start Products, Inc. "DP Five Start Epoxy Grout."
   3) Euclid Chemical "Euclid aggregate."
   4) Sika aggregate.
   5) Or equal.
d. Aggregate manufacturer shall be the same as the adhesive manufacturer.
e. The aggregate shall be compatible with the adhesive.
f. Each component furnished in separate package for mixing at jobsite.

D. Epoxy Bonding Adhesive:

1. Provide two-component, moister-insensitive adhesive manufactured for the purpose of bonding fresh concrete to hardened concrete.
2. Product and Manufacturer: Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
   a. Euco No.452 MV by Euclid Chemical Co.
   b. Sikadur 32, Hi-Mod by Sika Corporation.
   c. Or equal.

E. Epoxy Patch Material:

1. Engage the manufacturer’s representative to observe and recommend a suitable patching material of the actual construction conditions.
2. Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
   a. Depth of patch greater than 3/4 IN:
      1) Five Star MP Epoxy Patch.
      2) Or equal.
   b. Depth of patch between 1/8 IN and 3/4 IN:
      1) Five Star Fluid Epoxy.
      2) Or equal

PART 3 EXECUTION (NOT USED)

3.01 EXAMINATION

A. Examination and Assessment – General:

1. Examine surfaces to be cut or patched, and conditions under which cutting or patching will be performed before starting cutting or patching Work.
2. Report unsatisfactory or questionable conditions to Engineer in writing.
3. Do not proceed with cutting or patching Work until unsatisfactory conditions are corrected.

B. Non-Destructive Investigation:

1. In advance of cutting or coring through existing slabs or walls, use x-ray or other non-destructive methods accepted by Engineer to determine location of reinforcing steel, electrical conduits, and other items embedded in slabs and walls.
2. Submit to Engineer written report of findings of evaluation.
3. Perform x-ray investigation and submit results to Engineer sufficiently in advance of cutting Work to allow time to identify and implement alternatives, if changes to the Work are necessary because of conduit or other features in floor or wall.

3.02 PREPARATION

A. Provide temporary support required to maintain structural integrity of facilities, to protect adjacent work from damage during cutting, and to support the element(s) to be cut.

B. Protection of Existing Construction during Cutting and Patching:

1. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project and facility that will be exposed during cutting and patching operations.
2. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
3. Do not cut existing pipe, conduit, ductwork, or other utilities serving facilities scheduled to be removed or relocated until provisions have been made to bypass them.

3.03 CUTTING AND PATCHING – GENERAL

A. Perform cutting and coring in such manner that limits extent of patching required.

B. Structural Elements:

1. Do not cut or patch structural elements in manner that would change the element's structural load-carrying capacity as load deflection ratio.

C. Operating Elements:

1. Do not cut or patch operating elements in manner that would reduce their capacity to perform as intended.
2. Do not cut or patch operating elements or related components in manner that would increase maintenance requirements or decrease operational life or safety.

D. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using methods that do not void required or existing warranties.

E. Provide adequate temporary covering over openings (whether cut or core-drilled) where not in use. Avoid creating tripping hazards for openings provided in floors and slabs.

3.04 CORING

A. Use core-drilling to make penetrations through concrete and masonry walls, slabs, or arches, unless otherwise accepted by Engineer in writing.

B. Coring:

1. Perform coring with non-impact rotary tool using diamond core-drills. Size holes for pipe, conduit, sleeves, equipment or mechanical seals, as required, to be installed through the penetration.
2. Do not core-drill through electrical conduit or other utilities embedded in walls or slabs without approval of Engineer. To extent possible, avoid cutting reinforcing steel in slabs and walls.

C. Protection:

1. Protect existing equipment, utilities, and adjacent areas from water and other damage caused by or resulting from core-drilling operations.
2. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Specification Section. Apply protective coating in accordance with manufacturer's instructions.

D. Cleaning:

1. After core-drilling, vacuum or otherwise remove slurry and tailings from the work area.

3.05 CUTTING

A. Cutting – General:

1. Cut existing construction using methods least-likely to damage elements retained and adjoining construction and that provide proper surfaces to receive subsequent installation or repair.
2. In general, use hand tools or small power tools suitable for sawing or grinding. When possible, avoid using hammering and avoid chopping. Carefully chip out concrete where necessary and as indicated in the Contract Documents.
3. Cut holes and slots as small as possible, neatly to the size required, and with minimum disturbance of adjacent surfaces.
4. Prior to starting cutting, provide adequate bracing of area to be cut.
5. To avoid marring existing finished surfaces, cut or drill from exposed or finished side into concealed side.
6. Use equipment of adequate size to remove the cut panel or "coupon".

B. Cutting – Concrete and Masonry:

1. Cut through concrete and masonry using concrete wall saw with diamond saw blades.
2. On both sides of the element being cut, provide for control of slurry generated during sawing.
3. Concrete Cutting:
   a. Make openings by sawing through existing concrete. Core drill with 6 IN DIA core at the corners of openings to avoid overcutting at corners.
   b. When the cut-out concrete or "coupon" cannot be removed in one piece, or where concrete is too thick for saw to penetrate fully, break out concrete after initial saw cuts.
   c. Where saw cutting is not possible:
      1) Make openings by drilling holes around perimeter of required opening and subsequently carefully chip out concrete.
      2) Holes shall be sufficient in quantity to prevent damage to remaining concrete.
4. Sizing and Repair of Cut Concrete Surfaces:
   a. Where reinforcing steel is cut, remove existing reinforcing steel back to 1.5 IN below concrete surface. When using heat or torching to remove ends of reinforcing steel, remove adjacent, heat-damaged concrete prior to patching. Sides of resulting hole to be patched shall be approximately perpendicular to finished concrete surface. Provide bonding adhesive on surfaces of resulting holes and fill resulting holes with non-shrink grout in accordance with the Contract Documents.
   b. Oversize required openings in existing concrete by one inch on all sides and build back to required opening size by providing epoxy grout bonded to existing concrete.
   c. Where oversizing the cut opening by one inch is not possible, cut the opening to the required dimensions. After cutting concrete and before installing subsequent construction on or through the opening, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Specifications Section. Apply protective coating in accordance with manufacturer's instructions.

3.06 PATCHING

A. Patching – General:

1. Patch large openings to be filled with concrete in accordance with the Contract Documents. Before installing new concrete, apply bonding adhesive indicated in Paragraph 2.1.C of this Specifications section in accordance with manufacture's recommendations.
2. Where large openings to be filled with concrete are indicated on the Drawings as requiring reinforcing steel, provide reinforcing steel as shown and indicated in the Contract Documents. Where openings in

existing reinforced concrete are larger than 2 FT in diameter or 2 FT by 2 FT and the Drawings or elsewhere in the Contract Documents do not expressly require reinforcing steel for the opening, submit a request for interpretation to Engineer and obtain Engineer's response before proceeding.

3. Where concrete infill or grout repair materials are not used, patch using epoxy patch material indicated in Paragraph 2.1.D of this section unless otherwise indicated on Drawings.
4. Patch construction by filling, repairing, refinishing, closing-up, and similar operations following performance of other Work.
5. Patch with durable seams that are as inconspicuous as possible. Provide materials and comply with installation requirements indicated in the Contract Documents and the published installation instructions of the material's manufacturer.
6. Patch to provide airtight and watertight connections to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
7. Where feasible, test patched areas to demonstrate integrity of installation.

B. Restoration:

1. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in manner that eliminates evidence of patching and refinishing.
2. For continuous surfaces, refinish to nearest intersection.
3. For an assembly, refinish the entire unit that was patched.
4. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.07 CLEANING

A. Cleaning and Restoration:

1. Perform cleaning promptly after associated cutting, coring, and patching.
2. Clean areas and spaces where cutting, coring, or patching were performed.
3. Clean piping, conduit, and similar constructions before applying paint or other finishing materials.
4. Restore damaged coverings of pipe and other utilities to original condition.

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SECTION 01 75 00
CHECKOUT AND START-UP PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for checkout and startup of equipment, systems, and facilities.

B. Scope:

1. Contractor shall initially check out, start up, and place equipment and systems installed under the Contract into successful operation, in accordance with the material and equipment manufacturers' written instructions, Suppliers' recommendations at the Site, and the Contract Documents.
2. Provide the following:
   a. All labor, tools, materials, and equipment required to complete equipment and system checkout and startup.
   b. Chemicals, lubricants, and other required operating fluids necessary for checkout, startup, and initial operation of the Work.
   c. Filters and other temporary or consumable items necessary for checkout, startup, and initial operation of the Work.
   d. Fuel, electricity, water, and other temporary utilities and temporary facilities necessary for checkout and startup of equipment and systems, unless otherwise specified.
3. The General Conditions, as may be modified by the Supplementary Conditions, address requirements for documenting Substantial Completion.

C. Related Sections include but are not necessarily limited to:

1. Section 01 79 23 - Instruction of Operations and Maintenance Personnel
2. Section 40 90 00 - Instrumentation and Control for Process Systems

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate checkout and startup with other contractors, as necessary.
2. Do not start up equipment or system(s) for continuous operation until all components of that equipment item or system, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.

3. Subject to the constraints of this Specifications section, Owner will furnish sufficient personnel to assist Contractor in starting up equipment and system(s), but responsibility for proper operation of the Work is Contractor's.
4. Supplier shall be present during checkout, startup, and initial operation, unless otherwise acceptable to Engineer or otherwise required by the Contract Documents.
5. For startup of heating equipment, air conditioning equipment, and other equipment and systems that provide temperature control, that are dependent upon the time of year, return to the Site at beginning of next heating or cooling season (as applicable) to recheck and start the appropriate equipment and system(s).
6. Do not start up equipment and system(s), without submitting acceptable preliminary operations and maintenance manuals by Contractor in accordance with the Contract Documents.

B. Checkout and Startup Planning Meeting:

1. Contractor, with appropriate Subcontractors and Suppliers, shall attend and participate in a meeting with Owner, facility manager, and Engineer to discuss planning, scheduling, and coordination of checkout and startup activities.
2. Upon mutual concurrence of Owner, facility manager, Engineer, and Contractor, meeting may be concurrent with the training scheduling planning meeting required in Section 01 79 23 – Instruction of Operations and Maintenance Personnel.
3. Meeting shall be held by the earlier of: (1) not less than 60 days prior to first scheduled training session for the equipment and system(s) to be checked out and started-up, and (2) not less than 60 days prior to the checkout and startup of the associated equipment and system(s).
4. Attend meeting prepared to knowledgably and effectively discuss:
    a. Status of the Work and schedule-to-complete for requirements prerequisite to checkout and startup.
    b. Schedule for and status of training required for each equipment item and system.
    c. Schedule for checkout, startup, and field quality control activities for the subject Work.
    d. Status and quantities of required consumables, lubricants, and utility services necessary for checkout and startup.

C. Scheduling:

1. Progress Schedule:
    a. Clearly indicate in the Progress Schedule planned and actual dates for checkout, startup, and field quality control activities, including all demonstration testing activities addressed in this Specifications section and elsewhere in the Contract Documents. Separately indicate checkout, startup, and field quality control activities for each equipment item and system.

b. Perform startup and field quality control activities on the associated, scheduled dates, unless otherwise acceptable to Owner, facility manager, and Engineer.

2. Restrictions for Scheduling:
   a. Checkout of materials, equipment, and systems by Contractor that do not involve or require Owner's or facility manager's personnel may be performed at any time during normal working hours. Where required by the Contract Documents or requested by Engineer, perform checkout in the presence of Engineer or Resident Project Representative (RPR).
   b. Startup, including initial operation of materials, equipment, and systems, shall not be initiated on: Monday, Friday, Saturday, Sunday, Owen's holidays, the day immediately prior to a holiday, or the day immediately following a holiday, unless otherwise acceptable to Owner, facility manager, and Engineer.
   c. Unless otherwise indicated in the Contract Documents or acceptable to Owner, facility manager, and Engineer, perform all startup during normal working hours of the day shift.
   d. To the extent practicable, where extended-duration startup or field quality control activities are required by the Contract, avoid having such activities extend into evening, night, weekend, or holiday hours.
   e. Owner reserves the right to require a minimum seven days' notice of rescheduled startup when Contractor cannot perform the associated activities as scheduled.
3. Operation and Maintenance Data:
   a. A preliminary copy of all operation and maintenance manuals shall be received by Engineer prior to the start of the demonstration period.
4. Training:
   a. Comply with Section 01 79 23 - Instruction of Operations and Maintenance Personnel.
5. Spare Parts, Tools, and Extra Materials.
   a. Comply with individual Specification sections, for furnishing spare parts, tools, and extra materials to Owner and for documenting Owner's or facility manager's (as applicable) receipt of such items.
   b. Deliver to Owner or facility manager (as applicable) all required spare parts, tools, and extra materials prior to commencing the demonstration period unless earlier delivery is required elsewhere in the Contract Documents.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Do not start up equipment or systems or place into initial operation until required operating permits are obtained from authorities having jurisdiction.
2. Where Owner (with or without assistance of Engineer) has applied for and obtained initial approvals or permits necessary for operation, Contractor shall furnish information and assistance to Owner or Engineer for Owner to secure final approvals from authorities having jurisdiction for required operating permits.

1.04 DEFINITIONS

A. The following defined terms are used in this Specifications Section:

1. Instrumentation Supplier: Entity retained by Contractor, Subcontractor, or Supplier to furnish instrumentation or controls that will be part of the completed Work, including manufacturers, manufacturer representatives, wholesalers, retailers, and others, including entities retained to perform systems integration Work.
2. Project Classified System (PCS): An established, distinct part of the Project, consisting of an arrangement of items, such as equipment, structures, components, piping, cabling, materials, and incidentals, so related or connected to form an identifiable, unified, functional, operational, safe, and independent system. PCSs may be specifically indicated in this Specifications section or elsewhere in the Contract Documents.
3. Pre-Demonstration Period: The period of time, of unspecified duration after initial construction and installation activities during which Contractor, with assistance from manufacturer's representatives, performs in the following sequence:
   a. Finishing type construction work to ensure the Project has reached a state of Substantial Completion.
   b. Equipment start-up.
   c. Personnel training.
4. Demonstration Period: A period of time, of specified duration, following the Pre-Demonstration Period, during which the Contractor initiates process flow through the facility and starts up and operates the facility, without exceeding specified downtime limitations, to prove the functional integrity of the mechanical and electrical equipment and components and the control interfaces of the respective equipment and components comprising the facility as evidence of Substantial Completion.

1.05 SUBMITTALS

A. Action Submittals: Submit the following:

1. Data collection and reporting log for each required Demonstration Period.

B. Informational Submittals: Submit the following:

1. Progress Schedules indicating dates for checkout, startup, and field quality control activates.
2. Completed checkout and startup log required in Paragraph 3.2.C of this Specifications section.
3. Manufacturer's installation check letters (also known as Manufacturer's Field Services Report) required in Paragraph 3.2.C of this Specifications section.
4. Instrumentation Supplier's Instrumentation Installation Certificate, required in Paragraph 3.2.C of this Specifications section.
5. Letter verifying completion of all pre-demonstration startup activities, required in Paragraph 3.2.C of this Specifications section.
6. Report of data collected during each required Demonstration Period.
7. Qualifications Statements:
    a. Qualifications, including resume' and copy of license, of Contractor-retained licensed operator.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

3.01 CHECKOUT AND STARTUP – GENERAL

A. Facility Startup Divided into Two Periods:

1. Pre-Demonstration Period including:
    a. Obtain Engineer's approval or acceptance (as applicable) of Submittals required prior to checkout and startup, including all Shop Drawings, Samples, source quality control (shop testing) Submittals, preliminary operation and maintenance manuals, and other Submittals required by the Contract Documents, other than Submittals that cannot be furnished until after startup.
    b. Complete the Work to a point ready for checkout and startup, including operation available in all manual, automatic, and other modes.
    c. Checkout and initial field quality control activities that can be performed prior to startup of the equipment or system.
    d. Startup of the associated Work.
    e. Field quality control activities for the subject Work as indicated elsewhere in the Specifications and other Contract Documents, other than this section.
    f. Training of operations and maintenance personnel.
2. Demonstration Period, including:
    a. Demonstration of functional integrity of equipment, system, or PCS.

3.02 PRE-DEMONSTRATION PERIOD

A. Prior to the Pre-Demonstration Period, complete the Work to the point where it is ready for checkout and startup.

B. Checkout.

1. Comply with basic requirements, including provisions concerning installation checks.

C. Startup:

1. Comply with requirements for startup of materials, equipment, and systems indicated in the associated Specification sections and elsewhere in the Contract Documents.
2. Prepare the Work so it will operate properly and safely and be ready to demonstrate functional integrity during the Demonstration Period.
3. Perform startup to extent possible without introducing process flow.
4. Procedures include but are not necessarily limited to the following:
    a. Test or check and correct deficiencies of:
        1) Power, control, and monitoring circuits for continuity prior to connection to power source.
        2) Voltage of all circuits.
        3) Phase sequence.
        4) Cleanliness of connecting piping systems.
        5) Alignment of connected machinery.
        6) Vacuum and pressure of all closed systems.
        7) Lubrication.
        8) Valve orientation and position status for manual operating mode.
        9) Pumping equipment using clean water process flow.
        10) Instrumentation and control signal generation, transmission, reception, and response.
            a) Comply with Section 40 90 00 - Instrumentation and Control for Process Systems.
        11) Tagging and identification systems.
        12) Proper connections, alignment, calibration and adjustment.
    b. Calibrate safety equipment.
    c. Manually rotate or move moving parts to assure freedom of movement.
    d. “Bump-start” electric motors to verify proper rotation.
    e. Perform other tests, checks, and activities required to make the Work ready for Demonstration Period.
    f. Checkout and Startup Log:
        1) Prepare a log showing each equipment item and system requiring checkout and startup. Indicate in the log activities to be accomplished during checkout and startup.
        2) Provide a place for Contractor to record date and person performing required checkout and startup. Indicate associated date(s), personnel, and employer of each.
        3) Submit completed checkout and startup log to Engineer and obtain Engineer’s acceptance.

5. Obtain Suppliers' certifications of the installed and operational Work, without restrictions, and submit to Engineer:
    a. Manufacturer's installation check letters (sometimes referred to as Manufacturer's Field Services Report).
    b. Instrumentation Supplier's Instrumentation Installation Certificate.
6. Letter verifying completion of all pre-demonstration startup activities including receipt of all specified items from Suppliers as final item prior to initiation of Demonstration Period.

3.03 DEMONSTRATION PERIOD

A. Demonstration Period – General:

1. Demonstrate the operation and performance of mechanical, electrical, instrumentation, and control interfaces of the Work undergoing the Demonstration Period, in accordance with the Contract Documents.
2. See Section 40 90 00 (Instrumentation and Control for Process Sytems) for detailed requirements and procedures.
3. Owner's or Facility Manager's Personnel:
    a. Owner or facility manager (as applicable) will make available operations personnel to make process decisions affecting facility performance and compliance with applicable operating permits.
    b. Owner's or facility manager's assistance will be available only for process decisions.
    c. Contractor will perform all other functions associated with the Demonstration Period including but not limited to equipment operation and maintenance until successful completion of the Demonstration Period in accordance with the Contract Documents.
4. Owner or facility manager reserves the right to simulate operational variables, equipment failures, routine maintenance scenarios, and similar actions and events during the Demonstration Period to verify the operation and performance of the Work in automatic, manual, and other types of operating modes, backup systems, and alternate operating modes.

B. Demonstration Period, Evaluation, and Acceptance:

1. Throughout the Demonstration Period, provide knowledgeable personnel to answer Owner's or facility manager's questions, provide final field instruction on select systems (where appropriate) and to respond to problems or failures of the Work.
2. Responsibilities for Sampling and Data Collection:
    a. Use the data collection and reporting log format accepted by Engineer. Indicate data clearly and legibly.
3. Responsibilities for Data Reporting:
    a. Submit data collected to Engineer for evaluation of acceptability of results.
4. Data Evaluation:

a. Engineer, in consultation with Owner and facility manager (as applicable) as necessary, will evaluate the data collected during the Demonstration Period and other information obtained during the Demonstration Period for compliance with the Contract Documents.
b. Engineer will advise Contractor in writing of whether the data and information obtained indicate that the Demonstration Period was successfully completed.

END OF SECTION

SECTION 01 78 43
SPARE PARTS AND EXTRA MATERIALS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for furnishing spare parts, extra materials, maintenance supplies, and special tools required for maintenance (collectively, "spare parts and extra materials") required by the Contract Documents.

B. Scope:

1. Contractor shall furnish spare parts, extra materials, and associated information, for materials and equipment furnished in accordance with the Contract Documents. Furnish such items in accordance with the requirements of this Specifications section and the Specifications sections in which such items are indicated.
2. Contractor is fully responsible for loss and damage to spare parts and extra materials until such items are received by Owner's facility manager.
3. Promptly replace spare parts and extra materials furnished by Owner to Contractor for use in remedying defective Work.

C. List of Spare Parts and Extra Materials:

1. With the Shop Drawings and product data Submittals for each Specifications section, submit a complete listing of spare parts and extra materials necessary for maintenance for two years of operation, together with unit prices in current United States funds, and source(s) of supply for each.
2. Also include listing of spare parts and extra materials, with pricing and sources, in the operations and maintenance data submitted in accordance with the contract documents.

1.02 SUBMITTALS

A. Maintenance Material Submittals: Furnish and submit the following:

1. Spare Parts and Extra Materials:
   a. Furnish to Owner or facility manager in accordance with requirements of this Specifications section, and the Specifications section in which the spare parts and extra materials are specified.
2. Transfer Documentation: For each delivery of spare parts and extra materials, submit to Engineer the following:
   a. Submit, on Contractor's letterhead, a letter of transmittal for spare parts and extra materials furnished under each Specifications

section. Letter of transmittal shall accompany spare parts and extra materials. Do not furnish letter of transmittal separate from associated spare parts and extra materials.

b. Furnish three original, identical, signed letters of transmittal for each delivery of spare parts and extra materials furnished under each Specifications section. Upon delivery of specified quantities and types of spare parts and extra materials to Owner or facility manager, designated person from Owner or facility manager will countersign each original letter of transmittal indicating Owner's or facility manager's receipt of spare parts and extra materials in the quantity, type, and quality required by the Contract Documents. Owner or facility manager will retain one fully-signed original, Contractor shall submit one fully-signed original to Engineer. Contractor shall retain one fully-signed original for Contractor's records.

c. Letter of transmittal shall include the following:
   1) Transmittal shall list spare parts and extra materials furnished under the associated Specifications section. Indicate each individual part, material, equipment item, tool, and product and the associated quantity furnished.
   2) Include space for countersignature by Owner or facility manager as follows: space for signature, space for printed name, space for signatory's title, and date.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Packaging and Labeling of Spare Parts and Extra Materials:

1. Furnish spare parts and extra materials in manufacturer's unopened cartons, boxes, crates, or other original, protective covering suitable for preventing corrosion and deterioration.
2. Protect and package spare parts and extra materials for maximum shelf life normally anticipated by manufacturer.
3. Packaging of spare parts and extra materials shall be clearly marked and identified with name of manufacturer, applicable material or equipment, part number, part description, and part location in the equipment or system.

B. Storage Prior to Delivery to Owner:

1. Prior to furnishing spare parts and extra materials to Owner or facility manager, store spare parts and extra materials in accordance with the Contract Documents and manufacturers' written recommendations.

C. Procedure for Delivery to Owner or Facility Manager:

1. Deliver spare parts and extra materials to Owner's or facility manager's permanent storage rooms at the Site or area(s) at the Site designated by Owner or facility manager.
2. When spare parts and extra materials are delivered, Contractor and Owner (or facility manager) will mutually inventory the spare parts and extra materials delivered to verify compliance with the Contract Documents regarding quantity, part numbers, and quality.
3. Additional procedures for delivering spare parts and extra materials to Owner or facility manager, if required, will be developed by Engineer and complied with by Contractor.
4. Contractor shall reimburse Owner for all costs and expenses incurred by Owner and facility manager, including professional services, for delivery of inadequate, incorrect, or defective spare parts and extra materials. Owner may withhold such amounts from payments due Contractor via set-offs in accordance with the Contract Documents.

D. Delivery Time and Eligibility for Payment:

1. Deliver to Owner or facility manager spare parts and extra materials prior to date of Substantial Completion for materials and equipment associated therewith.
2. Do not deliver spare parts and extra materials before commencing startup for associated material or equipment.
3. Spare parts and extra materials are not eligible for payment until delivered to Owner or facility manager and Contractor's receipt of Owner's or facility manager's countersignature on letter of transmittal as required in this Specifications section.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 79 23
INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for instruction of operations and maintenance personnel.
2. Qualifications requirements for Suppliers' training personnel.
3. General requirements for training.
4. Schedule of required training sessions.

B. Scope:

1. Contractor shall furnish services of Suppliers' operation and maintenance training specialists to instruct Owner's personnel in recommended operating and maintenance procedures for materials and equipment furnished, in accordance with the Contract Documents.
2. Each Supplier shall provide a combination of classroom and field training at the Site, unless otherwise required elsewhere in the Contract Documents.
   a. Each of the courses shall be taught by authorized representatives of each respective equipment manufacturer, at the Contractor's approved staging site, City Operations facility, or other local facility as determined by the City's representative. Each manufacturer's representative shall be fully knowledgeable in the operations and maintenance of their equipment and shall be a full-time instructor under the employ of the respective manufacturer.
3. Owner reserves the right to record training sessions on video for Owner's later use in instructing Owner's personnel.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Scheduling of Training Sessions:

1. General:
   a. Contractor shall coordinate training services with checkout, startup, and initial operation of materials and equipment on days and times, and in manner, acceptable to Owner, in accordance with the Contract Documents.
   b. Training may be required outside of normal business hours to accommodate schedules of operations and maintenance personnel. Provide training services at the required days and times at no additional cost to Owner.
2. Prerequisites to Training:

a. Training of facility operations and maintenance personnel shall commence after preliminary operation and maintenance data has been submitted and accepted by Engineer, and the Work required in Section 01 75 00, Checkout and Startup Procedures, is complete.
b. At option of Owner or Engineer, training may be allowed to take place before, during, or after checkout and startup of materials and equipment.

3. Training Schedule Submittal:
   a. Training Schedule Required: Contractor shall prepare and submit proposed training schedule for review and acceptance by Engineer and Owner. Proposed training schedule shall show and indicate all training required in the Contract Documents, and shall demonstrate compliance with specified training requirements relative to number of hours of training for various elements of the Work, number of training sessions, and scheduling.
   b. Training Schedule Coordination: When Project has multiple prime contracts, prime Contractors shall comply with this Specifications section. All prime Contractors shall coordinate with the General Contractor in developing a single training schedule Submittal for the entire Project, to be submitted by General Contractor. All prime Contractors shall implement training in accordance with the approved training schedule.
   c. Timing of Training Schedule Submittal: Submit initial training schedule not less than 60 days before scheduled start of first training session. Submit final training schedule, incorporating revisions in accordance with Engineer's comments, not later than 30 days prior to starting the first training session.
   d. Owner reserves the right to modify personnel availability for training in accordance with process or emergency needs at the facility.

B. Training Scheduling Conference:

1. Prior to preparing initial training schedule Submittal, schedule and hold training scheduling conference at the location where progress meetings are held, to review:
   a. Training requirements indicated in the Contract Documents.
   b. Work to be completed prior to commencing training.
   c. Work progress and Progress Schedule relative to startup and training.
   d. Scheduling constraints for Owner's personnel, relative to days and times of training sessions.
   e. Preferred days for training.
   f. Location where training will be performed and facilities available.
   g. Required Submittals relative to training.

h. Other issues relative to training of operations and maintenance personnel.

2. Attendance is mandatory for the following:
   a. Contractor's project manager.
   b. Contractor's Site superintendent.
   c. Project manager of Subcontractors responsible for furnishing materials and equipment for which training of operations and maintenance personnel is required.
   d. Suppliers invited by Contractor.
   e. Engineer.
   f. Resident Project Representative (RPR).
   g. Owner's Site Representative (OSR).
   h. Facility manager's staff responsible for training coordination, and staff responsible for scheduling operations and maintenance personnel.
3. If additional information must be developed to adequately cover agenda items, reconvene conference as soon as possible.
4. Contractor shall prepare minutes summarizing the discussions of conference, decisions made, and agreements and disagreements, and distribute the minutes to each conference attendee and others as appropriate.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Supplier's Instructors:
   a. Shall be factory-trained by manufacturer of material or equipment.
   b. Supplier's instructors shall be proficient and experienced in performing training of the types required.
   c. Instructors shall be proficient, clear, and easily understandable in spoken and written English language.
   d. Qualifications of instructors are subject to acceptance by Engineer. If Engineer does not accept qualifications of proposed instructor, provide services of replacement instructor with acceptable qualifications.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Training Schedule: Detailed schedule of training sessions, demonstrating compliance with number of training sessions, hours required in the Contract Documents, and complying with the Contract Times. Submit training schedule Submittals in accordance with time frames specified in this Specifications section.

B. Informational Submittals: Submit the following:

1. Lesson Plan: Acceptable lesson plan for training on each material or equipment item, in accordance with Table 01 79 23-A and the Contract Documents. Lesson plan shall comply with requirements of this Specifications section as may be supplemented by Specifications sections where materials and equipment are specified. Include with lesson plan copy of handouts that will be used during training sessions. Submit lesson plan Submittals in accordance with time frames specified in this Specifications section.
2. Qualifications:
   a. Credentials of Supplier's proposed operations and maintenance instructor(s). Credentials shall demonstrate compliance with requirements of this Specifications section and shall include brief resume' and specific details of instructor's operating, maintenance, and training experience relative to the specific material and equipment for which instructor will provide training.
3. Minutes of training scheduling conference.

C. Closeout Submittals: Submit the following:

1. Trainee sign-in sheets for each training session. Submit to Owner's training coordinator with copy to Engineer.

1.05 LESSON PLAN

A. Supplier's lesson plan shall describe specific instruction topics, system components for which training will be provided, and training procedures. Handouts, if any, to be used in training shall be included with the lesson plan. Describe in lesson plan "hands-on" demonstrations planned for training sessions.

B. Submit acceptable lesson plan not less than 21 days prior to starting associated training.

C. Indicate in lesson plan estimated duration of each training segment.

D. Lesson plan shall include the following:

1. Material and Equipment Overview (required for all types of operations and maintenance training):
   a. Describe material and equipment's operating (process) function and performance objectives.
   b. Describe material and equipment's fundamental operating principles and dynamics.
   c. Identify equipment's mechanical, electrical, and electronic components and features. Group related components into subsystems and describe function of subsystem and subsystem's interaction with other subsystems.

d. Identify all support materials and equipment associated with operation of subject equipment, such as air intake filters, valve actuators, motors, and other appurtenant items and equipment.
e. Identify and describe safety precautions and potential hazards related to operation.
f. Identify and describe in detail safety and control interlocks.

2. Operations Personnel Training:
   a. Material and Equipment Overview: As described in Paragraph 1.5.D.1 of this Specifications section.
   b. Operation:
      1) Describe operating principles and practices.
      2) Describe routine operating, startup, and shutdown procedures.
      3) Describe abnormal or emergency startup, operating, and shutdown procedures that may apply.
      4) Describe alarm conditions and responses to alarms.
      5) Describe routine monitoring and recordkeeping procedures.
      6) Describe recommended housekeeping procedures.
   c. Troubleshooting:
      1) Describe how to determine if corrective maintenance or an operating parameter adjustment is required.
3. Mechanical Maintenance Training:
   a. Material and Equipment Overview: As described in Paragraph 1.5.D.1 of this Specifications section.
   b. Material and Equipment Preventive Maintenance:
      1) Describe preventative maintenance inspection procedures required to:
         a) Inspect materials and equipment in operation.
         b) Identify potential trouble symptoms and anticipate breakdowns.
         c) Forecast maintenance requirements (predictive maintenance).
      2) Define recommended preventative maintenance intervals for each component.
      3) Describe lubricant and replacement part recommendations and limitations.
      4) Describe appropriate cleaning practices and recommend intervals.
      5) Identify and describe use of special tools required for maintenance of materials and equipment.
      6) Describe component removal, installation, and disassembly and assembly procedures.
      7) Perform “hands-on” demonstrations of preventive maintenance procedures.

8) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
9) Define recommended torqueing, mounting, calibrating, and aligning procedures, tolerances, and settings, as appropriate.
10) Describe recommended procedures to check and test equipment following corrective maintenance.

c. Troubleshooting:
1) Define recommended systematic troubleshooting procedures.
2) Provide component-specific troubleshooting checklists.
3) Describe applicable materials and equipment testing and diagnostic procedures to facilitate troubleshooting.
4) Describe common corrective maintenance procedures with "hands-on" demonstrations.

4. Instrumentation/Controls and Electrical Maintenance Training:
a. Materials and Equipment Overview: As described in Paragraph 1.5.D.1 of this Specifications section.
b. Preventative Maintenance and Troubleshooting of Other Electrical Systems: In accordance with requirements for Paragraph 1.5.D.3 of this Specifications section.

1.06 TRAINING AIDS

A. Supplier's instructor(s) shall incorporate training aids as appropriate to assist in the instruction. Provide handouts of text, tables, graphs, and illustrations as required. Other appropriate training aids include:

1. Audio-visual aids, such as videos, Microsoft PowerPoint presentations, overhead transparencies, posters, drawings, diagrams, catalog sheets, or other items.
2. Equipment cutaways and samples, such as spare parts and damaged equipment.
3. Tools, such as repair tools, customized tools, and measuring and calibrating instruments.

B. Handouts:

1. Supplier's instructor(s) shall distribute and use descriptive handouts during training. Customized handouts developed especially for training for the Project are encouraged.
2. Photocopied handouts shall be good quality and completely legible.
3. Handouts shall be coordinated with the instruction, with frequent references made to the handouts.
4. Provide not less than 15 paper copies of each handout for each training session.

C. Audio-Visual Equipment: Training provider shall provide audio-visual equipment required for training sessions. If suitable equipment is available at

the Site, Owner may make available facility's expiring audio-visual equipment; however, do not count on facility's expiring audio-visual equipment, if any, being available. Audio-visual equipment that training provider shall provide, as required, includes:

1. Laptop computer, presentation software, and suitable projector.
2. Power cords, power strips/surge protectors.
3. As required, extension cords, HDMI cables and other video cabling, and spare bulb for projector.
4. Laser pointer/slideshow remote controller with extra batteries.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

3.01 TRAINING DELIVERY

A. Training Delivery – General:

1. Instructors shall be fully prepared for the training sessions. Training delivery shall be communicative, clear, and proceed according to lesson plan accepted by Engineer, with lesson content appropriate for trainees. If Owner or Engineer deems that training delivery does not comply with the Contract Documents, training shall be postponed, rescheduled, and re-performed in acceptable manner at no additional cost to Owner.
2. Trainee Sign-in Sheets: In format acceptable to Owner furnish sign-in sheet for trainees for each session. Sign-in sheets shall include the Project name; materials, equipment, or system for which training was provided; and type of training (e.g., operations, mechanical maintenance, instrumentation/controls and electrical maintenance, or other), and full name and operator license number (when applicable) of each trainee. Upon completion of training, submit copy of each sign-in sheet as indicated in Article 1.4 of this Specifications section.
3. Training shall be provided using the equipment of the same model and family being supplied as part of this project.
4. Training shall be conducted so as not to impact normal plant operations, or the construction schedule.
5. No course shall be provided at the same time as another unless otherwise permitted by the City's representative.
6. All training shall be monitored and approved by the City's representative. Any session or portion thereof deemed unsatisfactory, based on evaluation of the training shall be repeated at no additional cost to the CITY.

B. "Hands-on" Demonstrations:

1. Supplier's instructor(s) shall present "hands-on" demonstrations of operations and maintenance of materials and equipment for each training session, in accordance with lesson plan accepted by Engineer.
2. Contractor and manufacturer shall furnish tools necessary for demonstrations.

3.02 SCHEDULE OF REQUIRED TRAINING

A. Supplier shall provide not less than the hours of training and number of sessions indicated in Table 01 79 23-A of this Specifications Section. Travel time and expenses are responsibility of Supplier and are excluded from required training time indicated in the Contract Documents.

TABLE 01 79 23-A, TRAINING SUMMARY TABLE

Material or Equipment	Specification Section	Total Training (HRS	Training Sessions Required		
			Operations	Mechanic Maint.	Instrument/ Controls & Electrical Maint.

END OF SECTION

SECTION 02 41 00
DEMOLITION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. General provisions applicable to all demolition and removals.
2. Civil/site demolition and removals.
3. Mechanical demolition and removals
4. Electrical demolition and removals.
5. Disposal of demolition debris, materials, and equipment.

B. Scope:

1. Contractor shall provide all labor, materials, equipment, tools, and incidentals as shown, specified and required for demolition, removals, and disposal Work.
2. The Work under this Specifications section includes, but is not necessarily limited to:
   a. Demolition and removal of existing materials and equipment as shown or indicated in the Contract Documents. The Work includes demolition of gas sensors, gas monitoring panels, conductors, conduit and similar existing materials, equipment, and items.
   b. Perform demolition Work within areas shown or indicated.
   c. Pay all costs associated with transporting and, as applicable, disposing of materials and equipment resulting from demolition and removals Work.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Fire Protection Association (NFPA):
   a. 241, Safeguarding Construction, Alteration, and Demolition Operations.
2. Regulatory Requirements:
   a. Demolition, removals, and disposal Work shall be in accordance with 29 CFR 1926.850 through 29 CFR 1926.860 (Subpart T – Demolition), and all other Laws and Regulations.
   b. Comply with requirements of authorities having jurisdiction.
3. Qualifications:
   a. Electrical Removals: Entity and personnel performing electrical removals shall be electrician(s) legally qualified to perform

electrical construction and electrical work in the jurisdiction where the Site is located.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Review procedures under this and other Specifications sections and coordinate the Work that will be performed before, with, and after demolition and removals.

1.04 SITE CONDITIONS

A. Owner makes no representation of condition or structural integrity of area(s) to be demolished or where removals are required by the Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PREPARATION

A. Notification:

1. Not less than 48 HRS prior to commencing demolition or removal, advise Engineer in writing of planned start of demolition Work. Do not start removals without permission of Engineer.
2. Where demolition or removals has potential to affect adjacent properties, occupants, streets, or other public thoroughfare, transportation facilities, and utilities, furnish required notices to owners and occupants of properties, buildings, and structures that may be affected by the demolition of removal.
3. In accordance with Laws and Regulations, furnish to authorities having jurisdiction, including emergency services as necessary, appropriate notices of planned demolition and removals.
4. Submit to Engineer copies of notices furnished to adjacent property owners, occupants, and authorities having jurisdiction.

B. Protection of Adjacent Areas and Facilities:

1. Perform demolition and removal Work in manner that prevents damage and injury to property, structures, occupants, the public, and facilities. Do not interfere with use of, and free and safe access to and from, structures and properties unless allowed by the Contract Documents otherwise allowed in writing by Owner.
2. Closing or obstructing of roads, drives, sidewalks, and passageways adjacent to the Work is not allowed unless indicated otherwise in the

Contract Documents. Conduct the Work with minimum interference to vehicular and pedestrian traffic.

3. Provide temporary partitions between demolition work areas and (a) areas that will be occupied during demolition and removals, and (b) areas accessible to the public or visitors. Temporary partitions shall be sturdy, braced plywood in good condition, of dimensions sufficient to adequately screen demolition work from view of occupants, public, and visitors. Maintain temporary partitions in place until demolition and removals work in the subject area is complete or until other Work requires removal of temporary partitions.
4. Provide appropriate temporary barriers, lighting, sidewalk sheds, and other necessary protection.
5. Repair damage to facilities that are to remain which such damages results from Contractor's operations.

3.02 DEMOLITION – GENERAL

A. Demolition shown on the Drawings is based on the as-builts. Contractor shall field verify equipment, locations, routing, and sizes prior to demolition.

1. Existing conduit routing is shown schematically. Contractor shall field verify routing prior to demolition. Additional conduit length that requires demolition shall be at no additional cost.
2. Conduit supports, pull boxes, junction boxes, and other ancillary equipment are not usually shown. Contractor shall field verify all equipment associated with the demolition shown on the Drawings prior to demolition. Additional conduit supports, pull boxes, junction boxes, and other ancillary equipment requiring demolition shall be at no additional cost.

B. Locate construction equipment used for demolition Work and remove demolished materials and equipment to avoid imposing excessive loading on supporting and adjacent walls, floors, framing, facilities, and Underground Facilities.

C. Pollution Controls:

1. Use water sprinkling, temporary enclosures, and other suitable methods to limit emissions of dust and dirt to lowest practical level.
2. Do not use water when water may create hazardous or objectionable conditions such as icing, flooding, or pollution.
3. Clean adjacent structures, facilities, properties, and improvements of dust, dirt, and debris caused by demolition Work, in accordance with the General Conditions, the Greenbook, and the Whitebook.

D. Explosives:

1. Explosives are not allowed at the Site. Do not use explosives for demolition and removal Work.

E. Comply with Section 01 73 29 – Cutting and Patching, the Greenbook, Whitebook and NFPA 241.

F. Finishing of Surfaces Exposed by Removals: Unless otherwise shown or indicated in the Contract Documents, surfaces of walls, floors, ceilings, and other areas exposed by removals, and that will remain as finished surfaces, shall be repaired and re-finished with materials that match existing adjacent surface, or as otherwise approved by Engineer.

G. Removal of Existing Anchor Bolts or Other Protruding Elements:

1. Remove all protruding elements.
2. Remove to a depth of ¼ IN from finished surface.
3. Fill void with epoxy patch.

H. Matching and Painting:

1. Walls, ceilings, floors, or partitions.
   a. Repair abutting walls, ceilings, floors or partitions disturbed by removal.
   b. Match and patch existing construction disturbed during installation of new work.
2. Methods and materials:
   a. Similar in appearance, and equal in quality to adjacent areas for areas or surfaces being repaired.
   b. Subject to review of Owner.

3.03 ELECTRICAL REMOVALS

A. Electrical demolition Work includes removing existing:

1. Disconnecting cabling from electrical sources, control panels, control stations, instrumentation and control items, and similar devices and equipment.
2. Conduits, raceways, cable trays, hangers and supports, cabling, and related items.
3. Switches, panelboards, control stations, and similar items.
4. Control panels, instrumentation, and similar items.
5. Appurtenances and miscellaneous electrical equipment, as shown, specified, or required.

B. Electrical Removals – General:

1. Comply with Laws and Regulations, including the National Electric Code.

2. Lock Out and Tagging:
    a. Contractor shall lock out and tag circuit breakers and switches operated by Owner and shall verify that affected cabling are de-energized to ground potential before commencing electrical removals Work.
    b. Upon completion of electrical removals Work, remove the locks and tags and promptly advise Resident Project Representative (RPR) or Engineer and Owner that existing facilities are available for use.
3. Remove existing electrical equipment, fixtures, and systems to avoid damaging systems to remain, to keep existing systems in operation, and to maintain integrity of grounding systems.
4. Disconnect and remove motors, control panels, and other electrical gear where shown or indicated.
5. Store removed motors, microprocessors and electronics, and other electrical gear to be reused in accordance with its manufacturer's recommendations and requirements of the Contract Documents.

C. Removal of Cabling, Conduits, Raceways and Similar Items:

1. Verify the function of each cable before disconnecting and removing.
2. Remove cabling, conduits, hangers and supports, and similar items back to the power source or control panel, unless otherwise shown or indicated.
3. Remove cabling, conduits, and similar items where shown or indicated for removal. Cables shall be removed from end to end. Abandoned conduits concealed in floor, ceiling slabs, or in walls shall be cut flush with the slab or wall (as applicable) at point of entrance, suitably capped, and the area repaired in a flush, smooth manner acceptable to Engineer and as indicated on the Drawings.
4. Disassemble and remove exposed conduits, junction boxes, other electrical appurtenances, and their supports.
5. Repair all areas of the Work to prevent rusting on exposed surfaces.
6. Underground Electric:
    a. Conduits in Underground Facilities not scheduled for reuse shall be suitably capped watertight where each enters building or structure to remain.
    b. Where shown or indicated, remove direct-burial cabling. Openings in buildings for entrance of direct-burial cabling shall be patched with repair mortar or other material approved by Engineer for such purpose, and made watertight.

D. Lighting fixtures, wall switches, receptacles, starters, and other miscellaneous electrical equipment, not designated as remaining as Owner's property, shall be removed and properly disposed off-Site as required in accordance with Laws and Regulations.

3.04 DISPOSAL OF DEMOLITION DEBRIS

A. Disposal – General:

1. Promptly remove from the Site all debris, waste, rubbish, material, and equipment resulting from demolition and removal operations. Promptly upon completion of demolition and removal operations, remove from the Site construction equipment used in demolition Work.
2. Do not sell at the Site demolition materials or removed equipment. If materials, equipment or debris will be sold by Contractor, remove the items from the Site and perform the sale or transaction elsewhere, in accordance with Laws and Regulations.
3. Cleaning and Removal of Debris: Comply with the General Conditions, Supplementary Conditions, the Greenbook, and the Whitebook.

B. Transportation and Disposal:

1. Non-Hazardous Materials, Equipment, and Debris: Properly transport and dispose of non-hazardous demolition materials, equipment, and debris at appropriate landfill or other suitable location, in accordance with Laws and Regulations. Non-hazardous material does not contain Constituents of Concern such as (but not limited to) asbestos, PCBs, petroleum, hazardous waste, radioactive material, or other material designated as hazardous in Laws or Regulations.
2. Hazardous Materials, Equipment, Electronics and Debris: When handling and disposal of items containing Constituents of Concern is included in the Work, properly transport and dispose of such items in accordance with the Contract Documents and Laws and Regulations.

C. Submit to Engineer information required in this Specification Section on proposed facility(ies) where demolition materials, equipment, and debris will be recycled. Upon request, Engineer or Owner, shall be allowed to visit recycling facility(ies) to verify adequacy and compliance status. During such visits, recycling facility operator shall cooperate and assist Engineer and Owner.

END OF SECTION

SECTION 26 05 02
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Requirements specified within this section apply to Division 26, Electrical. Work specified herein shall be performed as if specified in the individual sections.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
2. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. Z535.4, Product Safety Signs and Labels.
3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
4. Underwriters Laboratories, Inc. (UL).

1.03 DEFINITIONS

A. For the purposes of providing materials and installing electrical work the following definitions shall be used.

B. Outdoor area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.

C. Architecturally finished interior area: Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.

D. Non-architecturally finished interior area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.

E. Highly corrosive and corrosive area: Areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.

F. Hazardous areas: Class I, II or III areas as defined in NFPA 70.

G. Shop fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.

1.04 QUALITY ASSURANCE

A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.

B. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark or label.

C. Provide materials and equipment acceptable to AHJ for Class, Division, and Group of hazardous area indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect nameplates on electrical equipment to prevent defacing.

1.06 ENVIRONMENTAL CONDITIONS

A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.

1. Outdoor areas:
   a. Wet.
   b. Also, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.
2. Indoor areas:
   a. Dry.
   b. Also, wet, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.

PART 2 PRODUCTS

2.01 GENERAL

A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.

C. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the ambient temperature range.

2.02 EQUIPMENT FINISH

A. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with light gray color finish as approved by Engineer.

2.03 NAMEPLATES

A. Material: Laminated plastic.

B. Attachment Screws: Stainless steel.

C. Color: Black, engraved to a white core.

D. Letter Height:

1. Pushbuttons/Selector Switches: 1/8 inch.
2. Other electrical equipment: 1/4 inch.

2.04 SIGNS AND LABELS

A. Sign size, lettering, and color shall be in accordance with NEMA Z535.4.

PART 3 EXECUTION

3.01 GENERAL

A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Contractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Engineer.

B. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify Engineer in writing.

C. Install work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Keep openings in boxes and equipment closed during construction.

E. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.

F. Do not use equipment that exceed dimensions or reduce clearances indicated on the Drawings or as required by the NFPA 70.

G. Install equipment plumb, square and true with construction features and securely fastened.

H. Install electrical equipment, including pull and junction boxes, minimum of 6 IN from process, gas, air and water piping and equipment.

B. Install equipment so it is readily accessible for operation and maintenance, is not blocked or concealed and does not interfere with normal operation and maintenance requirements of other equipment.

C. Device Mounting Schedule:

1. Unless indicated otherwise on the Drawings, mounting heights are as indicated below:
   a. Light switch (to center): 46 IN.
   b. Receptacle in architecturally finished areas (to center): 18 IN.
   c. Receptacle on exterior wall of building (to center): 18 IN.
   d. Receptacle in non-architecturally finished areas (to center): 46 IN.
   e. Telephone outlet in architecturally finished areas (to center): 18 IN.
   f. Telephone outlet for wall-mounted phone (to center): 46 IN.
   g. Safety switch (to center of operating handle): 54 IN.
   h. Separately mounted motor starter (to center of operating handle): 54 IN.
   i. Pushbutton or selector switch control station (to center): 46 IN.
   j. Panelboard (to top): 72 IN.

D. Avoid interference of electrical equipment operation and maintenance with structural members, building features and equipment of other trades.

1. When it is necessary to adjust the intended location of electrical equipment, unless specifically dimensioned or detailed, the Contractor may make adjustments of up to 6 IN in equipment location with the Engineer's approval.

E. Provide non-metallic corrosion resistant spacers to maintain 1/4 IN separation between metallic equipment and/or metallic equipment supports and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Basins, Clarifiers, Digesters, Reservoirs, etc.

F. Do not place equipment fabricated from aluminum in direct contact with earth or concrete.

G. Screen or seal all openings into equipment mounted outdoors to prevent the entrance of rodents and insects.

H. Do not use materials that may cause the walls or roof of a building to discolor or rust.

3.02 ANCHORING AND MOUNTING

A. Equipment anchoring and mounting shall be in accordance with manufacturer's requirements for seismic zone criteria given in Section 26 05 48 – Electrical Seismic Restraint Systems.

1. Do not cut, or weld to, building structural members.
2. Do not mount safety switches or other equipment to equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

B. Provide all necessary anchoring devices and supports rated for the equipment load based on dimensions and weights verified from approved submittals, or as recommended by the manufacturer.

C. Provide non-metallic corrosion resistant spacers to maintain 1/4 IN separation between metallic equipment and/or metallic equipment supports and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Basins, Clarifiers, Digesters, Reservoirs, etc.

D. Do not place equipment fabricated from aluminum in direct contact with earth or concrete.

E. Screen or seal all openings into equipment mounted outdoors to prevent the entrance of rodents and insects.

F. Do not use materials that may cause the walls or roof of a building to discolor or rust.

G. See Specification Section 26 05 48 - Electrical Seismic Restraint Systems for additional requirements.

3.03 COMBINING CIRCUITS INTO COMMON RACEWAY

A. Drawings show each homerun circuit to be provided. Do not combine power or control circuits into common raceways without authorization of Engineer.

B. Homerun circuits shown on Drawings indicate functional wiring requirements for power and control circuits. Circuits may be combined into common raceways in accordance with the following requirements:

1. Analog control circuits from devices in same general area to same destination.
    a. No power or AC discrete control circuits shall be combined in same conduit with analog circuits.

b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, paging system circuits shall be combined with power or Class 1 circuits.
c. Analog circuits shall be continuous from source to destination. Do not add TJB, splice, or combine into a multi-pair cable without authorization of Engineer.
d. Raceways shall be sized per General Circuit and Raceway Schedule and do not exceed 40 percent fill.
e. Changes shall be documented on record drawings.

2. Discrete control circuits from devices in the same general area to the same destination.
   a. No power or analog control circuits shall be combined in same conduit with discrete circuits.
   b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, and paging system circuits shall be combined with power or Class 1 circuits.
   c. Raceways shall be sized per the General Circuit and Raceway Schedule and do not exceed 40 percent fill.
   d. Changes shall be documented on record drawings.

3. Power circuits from loads in same general area to same source location (such as: panelboard, switchboard, low voltage motor control center).
   a. Lighting Circuits: Combine no more than three circuits to a single raceway. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
   b. Receptacle Circuits, 120-Volt Only: Combine no more than three circuits to a single raceway. Provide a separate neutral conductor for each circuit. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
   c. All Other Power Circuits: Do not combine power circuits without authorization of Engineer.

3.04 NAMEPLATES, SIGNS, AND LABELS

A. Equipment Nameplates:

1. Provide a nameplate to label electrical equipment including terminal junction boxes, local control panels, and instrumentations (transmitters and elements).
2. Terminal junction box, local control panels, and instrumentation (transmitters and elements) nameplates shall include equipment designation.
3. Local control panels and instrumentation transmitters nameplates shall include name and number of equipment powered or controlled by that device.

3.05 LOAD BALANCE

A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.

B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.

C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.06 CLEANING AND TOUCHUP PAINTING

A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming.

B. Touchup Paint:

1. Touchup scratches, scrapes and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.
2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Engineer.

3.07 PROTECTION FOLLOWING INSTALLATION

A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.

B. When equipment intended for indoor installation is installed at Contractor's convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Engineer.

END OF SECTION

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SECTION 26 05 04
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
   b. E814, Method of Fire Tests of Through-Penetration Fire Stops.
2. Canadian Standards Association (CSA).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
4. International Society of Automation (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. C12.1, Code for Electricity Metering.
   c. C12.6, Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals.
   d. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
   e. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
   f. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. UL:
   a. 98, Standard for Enclosed and Dead-Front Switches.
   b. 248, Standard for Low Voltage Fuses.
   c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
   d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
   e. 508, Standard for Industrial Control Equipment.
   f. 810, Standard for Capacitors.
   g. 943, Standard for Ground-Fault Circuit-Interrupters.
   h. 1059, Standard for Terminal Blocks.
   i. 1479, Fire Tests of Through-Penetration Fire Stops.

1.02 SUBMITTALS

A. Action Submittals:

1. Provide manufacturers' data for the following:
   a. Control devices.
   b. Control relays.
   c. Circuit breakers.
   d. Fused switches.
   e. Nonfused switches.
   f. Timers.
   g. Fuses.
   h. Intrinsic safety barriers.
   i. Firestopping.
   j. Enclosures: Include enclosure data for products having enclosures.
   k. DC power supplies.
2. Seismic anchorage and bracing drawings and cut sheets.

PART 2 PRODUCTS

2.01 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.

B. Selector Switch Operating Lever: Standard.

C. Indicating Light: LED, full voltage, push-to-test.

D. Pushbutton Color:

1. ON or START:Geen.
2. OFF or STOP: Red.

E. Pushbutton and selector switch lockable in OFF position where indicated.

F. Legend Plate:

1. Material: Aluminum.
2. Engraving: Enamel filled in high contrasting color.
3. Text Arrangement: 11-character/spaces on one line, 14-character/spaces on each of two lines, as required, indicating specific function.
4. Letter Height: 7/64 inch.

G. Manufacturers and Products:

1. Heavy-Duty, Oil-Tight Type:

a. General Electric Co.; Type CR 104P.
b. Square D Co.; Type T.
c. Eaton/Cutler-Hammer; Type 10250T.
d. Or equal.

2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
a. Square D Co.; Type SK.
b. General Electric Co.; Type CR 104P.
c. Eaton/Cutler-Hammer; Type E34.
d. Crouse-Hinds; Type NCS.
e. Or equal.

2.02 MAGNETIC CONTROL RELAY

A. Industrial control with field convertible contacts rated 10 amps continuous, 7,200VA make, 720VA break.

B. NEMA ICS 2, Designation: A600 (600 volts).

C. Time Delay Relay Attachment:

1. Pneumatic type, timer adjustable as shown.
2. Field convertible from ON delay to OFF delay and vice versa.

D. Latching Attachment: Mechanical latch, having unlatching coil and coil clearing contacts.

E. Manufacturers and Products:

1. Eaton/Cutler-Hammer; D26 Type M.
2. General Electric Co.; Type CR120A.
3. Square D; Type X.
4. Or equal.

2.03 TIME DELAY RELAY

A. Industrial relay with contacts rated 5 amps continuous, 3,600VA make, 360VA break.

B. NEMA ICS 2 Designation: B150 (150 volts).

C. Solid-state electronic, field convertible ON/OFF delay.

D. One normally open and one normally closed contact (minimum).

E. Repeat accuracy plus or minus 2 percent.

F. Timer adjustment from 1 second to 60 seconds, unless otherwise indicated on Drawings.

G. Manufacturers and Products:

1. Square D Co.; Type XO.
2. Eaton/Cutler-Hammer; Type D26MR.
3. General Electric Co.; Type CR120.
4. Or equal.

2.04 SUPPORT AND FRAMING CHANNELS

A. Galvanized steel: ASTM A123/123M or ASTM A153/A153M.

B. Stainless steel: AISI Type 316.

C. PVC coated galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 MIL PVC coating.

D. Manufacturers:

1. B-Line Systems, Inc.
2. Unistrut Corp.
3. Aickinstrut.
4. Or equal.

2.05 FIRESTOPS

A. General:

1. Provide UL 1479 classified hourly fire rating equal to, or greater than, the assembly penetrated.
2. Prevent the passage of cold smoke, toxic fumes, and water before and after exposure to flame.
3. Sealants and accessories shall have fire-resistance ratings as established by testing identical assemblies in accordance with ASTM E814, by UL, or other testing and inspection agency acceptable to authorities having jurisdiction.

B. Firestop System:

1. Formulated for use in through-penetration firestopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors.
2. Fill, Void, or Cavity Material: 3M Brand Fire Barrier Caulk CP25, Putty 303, Wrap/Strip FS195, Composite Sheet CS195 and Penetration Sealing Systems 7902 and 7904 Series.
3. Two-Part, Foamed-In-Place, Silicone Sealant: Dow Corning Corp. Fire Stop Foam, General Electric Co.; Pensil 851.
4. Fire Stop Devices: See Section 26 05 33, Raceway and Boxes, for raceway and cable fittings.

2.06 ENCLOSURES

A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.

B. Color: Manufacturer's standard color (gray) baked-on enamel, unless otherwise shown.

C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.

D. Enclosure Selections: Except as shown otherwise, provide electrical enclosures according to the Area Classification and Material Selection Table on Drawings.

2.07 DC POWER SUPPLIES

A. Manufacturers:

1. Sola Hevi-Duty.
2. Phoenix Contact.
3. Rockwell Automation.

B. Design and fabrication:

1. Converts 120 VAC input to DC power at required voltage.
2. DIN rail mount with enclosure (i.e., not open frame).
3. Switching type.
4. Provide redundant 24VDC modules with diode redundancy module for automatic switchover to standby module on failure of primary module.
5. Hardwire module fault dry contact to associated PLC input for alarm at Plant SCADA.
6. AC input: 120 VAC ±15%, nominal 60 Hz.
7. Efficiency: Minimum 86%.
8. Rated mean time between failure (MTBF): 500,000 HRS.
   a. Voltage regulation:
      1) Static: Less than 1.0% Vout.
      2) Dynamic: ±2% Vout overall.
9. Output ripple/noise: Less than 100 mV peak to peak (20 MHz).
10. Overload, short circuit and open circuit protection.
11. Temperature rating: 0 to 60 DEGC full rated, derated linearly to 50% at 70 DEGC.
12. Humidity rating: Up to 90%, non-condensing.
13. LED status indication for DC power.
14. UL listed.

PART 3 EXECUTION

3.01 GENERAL

A. Install equipment in accordance with manufacturer's recommendations.

3.02 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Install heavy-duty, oil-tight type in nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations, unless otherwise shown.

B. Install heavy-duty, watertight and corrosion-resistant type in nonhazardous, outdoor, or normally wet areas, unless otherwise shown.

3.03 SUPPORT AND FRAMING CHANNEL

A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.

B. Provide electrical equipment support system per the following area designations:

1. Dry areas:
   a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
   b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
2. Wet areas:
   a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
   b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
3. Corrosive areas:
   a. Stainless steel system consisting of stainless steel channels and fittings, nuts and hardware.

C. Paint cut ends prior to installation with the following:

1. Galvanized Steel Channel: Zinc-rich primer.
2. Painted Channel: Rust-inhibiting epoxy or acrylic paint.
3. PVC-Coated Channel: PVC patch.

3.04 INTRINSIC SAFETY BARRIERS

A. Install in compliance with ISA RP12.06.01.

B. Arrange conductors such that wiring from hazardous areas cannot short to wiring from nonhazardous area.

C. Stencil “INTRINSICALLY SAFE CIRCUIT” on all boxes enclosing barriers.

3.05 FIRESTOPS

A. Install in strict conformance with manufacturer’s instructions. Comply with installation requirements established by testing and inspecting agency.

B. Sealant: Install sealant including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide firestops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs.

END OF SECTION

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SECTION 26 05 05
CONDUCTORS

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Related Specification Sections include but are not limited to:

1. Section 26 05 02 - Basic Electrical Requirements.
2. Section 26 05 04 - Basic Electrical Materials and Methods.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Association of Edison Illuminating Companies (AEIC): CS 8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 kV through 46 kV.
2. ASTM International (ASTM):
    a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
    b. B3, Standard Specification for Soft or Annealed Copper Wire.
    c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
    d. B496, Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    a. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV Through 500 kV.
    b. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
    c. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500000 V.
4. Insulated Cable Engineer’s Association, Inc. (ICEA):
    a. S-58-679, Standard for Control Cable Conductor Identification.
    b. S-73-532, Standard for Control Thermocouple Extensions and Instrumentation Cables.
    c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.
5. National Electrical Manufacturers’ Association (NEMA):

a. CC 1, Electric Power Connectors for Substations.
b. WC 57, Standard for Control, Thermocouple Extension, and Instrumentation Cables.
c. WC 70, Standard for Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
d. WC 71, Standard for Nonshielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy.
e. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.

6. National Fire Protection Association (NFPA):

a. 70, National Electrical Code (NEC).
b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

7. Telecommunications Industry Association (TIA): TIA-568-C, Commercial Building Telecommunications Cabling Standard.
8. Underwriters Laboratories Inc. (UL):

a. 13, Standard for Safety for Power-Limited Circuit Cables.
b. 44, Standard for Safety for Thermoset-Insulated Wires and Cables.
c. 62, Standard for Safety for Flexible Cord and Cables.
d. 486A-486B, Standard for Safety for Wire Connectors.
e. 486C, Standard for Safety for Splicing Wire Connectors.
f. 510, Standard for Safety for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
g. 854, Standard for Safety for Service-Entrance Cables.
h. 1072, Standard for Safety for Medium-Voltage Power Cables.
i. 1277, Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
j. 1569, Standard for Safety for Metal-Clad Cables.
k. 1581, Standard for Safety for Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.03 SUBMITTALS

A. Action Submittals:

1. Product Data:

a. Wire and cable.
b. Wire and cable accessories.
c. Cable fault detection system.

2. Manufactured Wire Systems:

a. Product data.

b. Rating information.
c. Dimensional drawings.
d. Special fittings.

B. Informational Submittals:

1. Journeyman lineman or electrician splicing credentials.
2. Certified Factory Test Report for conductors 600 volts and below.
3. Certified Factory Test Report per AEIC CS 8, including AEIC qualification report for conductors above 600 volts.

1.04 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.01 CONDUCTORS 600 VOLTS AND BELOW

A. Conform to applicable requirements of NEMA WC 70.

B. Conductor Type:

1. 120-Volt and 277-Volt Lighting, 10 AWG and Smaller: Solid copper.
2. 120-Volt Receptacle Circuits, 10 AWG and Smaller: Solid copper.
3. All Other Circuits: Stranded copper.

C. Insulation: Type THHN/THWN-2, except for sizes No. 6 and larger, with XHHW-2 insulation.

D. Direct Burial and Aerial Conductors and Cables:

1. Type USE/RHH/RHW insulation, UL 854 listed, or Type RHW-2/USE-2.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

E. Flexible Cords and Cables:

1. Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

2.02 600-VOLT RATED CABLE

A. General:

1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 70,000 BTU per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Type 1, Multiconductor Control Cable:

1. Conductors:

   a. 14 AWG, seven-strand copper.
   b. Insulation: 15-mil PVC with 4-mil nylon.
   c. UL 1581 listed as Type THHN/THWN rated VW-1.
   d. Conductor group bound with spiral wrap of barrier tape.
   e. Color Code: In accordance with ICEA S-58-679, Method 1, Table 2.
2. Cable: Passes the ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
3. Cable Sizes:

No. of Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
3	0.41	45
5	0.48	45
7	0.52	45
12	0.72	60
19	0.83	60

No. of Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
25	1.00	60
37	1.15	80

4. Manufacturers:

    a. Okonite Co.
    b. Southwire.
    c. Or equal.

C. Type 3, 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.

1. Outer Jacket: 45-mil nominal thickness.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
3. Dimension: 0.31-inch nominal OD.
4. Conductors:

    a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
    b. 20 AWG, seven-strand tinned copper drain wire.
    c. Insulation: 15-mil nominal PVC.
    d. Jacket: 4-mil nominal nylon.
    e. Color Code: Pair conductors, black and red.

5. Manufacturers:

    a. Okonite Co.
    b. Alpha Wire Corp.
    c. Belden.
    d. Or equal.

2.03 GROUNDING CONDUCTORS

A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.

B. Direct Buried: Bare stranded copper.

2.04 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

A. Tape:

1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
3. Arc and Fireproofing:

    a. 30-mil, elastomer.
    b. Manufacturers and Products:
        1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
        2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.
        3) Or equal.

B. Identification Devices:

1. Sleeve:

    a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
    b. Manufacturers and Products:
        1) Raychem; Type D-SCE or ZH-SCE.
        2) Brady, Type 3PS.
        3) Or equal.
2. Heat Bond Marker:

    a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
    b. Self-laminating protective shield over text.
    c. Machine printed black text.
    d. Manufacturer and Product: 3M Co.; Type SCS-HB or equal.
3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
4. Tie-On Cable Marker Tags:

    a. Chemical-resistant white tag.
    b. Size: 1/2 inch by 2 inches.
    c. Manufacturer and Product: Raychem; Type CM-SCE or equal.
5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:

    a. Manufacturers and Products:

1) Thomas & Betts; Sta-Kon.
2) Burndy; Insulug.
3) ILSCO.
4) Or equal.

2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:

a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
b. Seamless.
c. Manufacturers and Products:
1) Thomas & Betts; Sta-Kon.
2) Burndy; Insulink.
3) ILSCO; ILSCONS.
4) Or equal.

3. Self-Insulated, Freespring Wire Connector (Wire Nuts):

a. UL 486C.
b. Plated steel, square wire springs.
c. Manufacturers and Products:
1) Thomas & Betts.
2) Ideal; Twister.
3) Or equal.

4. Self-Insulated, Set Screw Wire Connector:

a. Two piece compression type with set screw in brass barrel.
b. Insulated by insulator cap screwed over brass barrel.
c. Manufacturers:
1) 3M Co.
2) Thomas & Betts.
3) Marrette.
4) Or equal.

D. Cable Lugs:

1. In accordance with NEMA CC 1.
2. Rated 600 volts of same material as conductor metal.
3. Uninsulated Crimp Connectors and Terminators:

a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
b. Manufacturers and Products:
1) Thomas & Betts; Color-Keyed.
2) Burndy; Hydent.
3) ILSCO.

4. Uninsulated, Bolted, Two-Way Connectors and Terminators:

a. Manufacturers and Products:
   1) Thomas & Betts; Locktite.
   2) Burndy; Quiklug.
   3) ILSCO.
   4) Or equal.

E. Cable Ties:

1. Nylon, adjustable, self-locking, and reusable.
2. Manufacturer and Product: Thomas & Betts; TY-RAP or equal.

F. Heat Shrinkable Insulation:

1. Thermally stabilized cross-linked polyolefin.
2. Single wall for insulation and strain relief.
3. Dual Wall, adhesive sealant lined, for sealing and corrosion resistance.
4. Manufacturers and Products:

   a. Thomas & Betts; SHRINK-KON.
   b. Raychem; RNF-100 and ES-2000.
   c. Or equal.

2.05 PULLING COMPOUND

A. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.

B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.

C. Approved for intended use by cable manufacturer.

D. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.

E. Manufacturers:

1. Ideal Co.
2. Polywater, Inc.
3. Cable Grip Co.
4. Or equal.

2.06 WARNING TAPE

A. As specified in Section 26 05 33, Raceway and Boxes.

2.07 SOURCE QUALITY CONTROL

A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.

PART 3 EXECUTION

3.01 GENERAL

A. Conductor installation shall be in accordance with manufacturer's recommendations.

B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.

C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.

D. Terminate conductors and cables, unless otherwise indicated.

E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors.

F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.

G. Bundling: Where single conductors and cables in handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding **12** inches on center.

H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.

3.02 POWER CONDUCTOR COLOR CODING

A. Conductors 600 Volts and Below:

1. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.
2. 8 AWG and Smaller: Provide colored conductors.
3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green

System	Conductor	Color
240/120 Volts, Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts, Three-Phase, Four-Wire, Delta, Center Tap, Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Brown Orange Yellow
Note: Phase A, B, C implies direction of positive phase rotation.		

4. Tracer: Outer covering of white with identifiable colored strip, other than green, in accordance with NFPA 70.
5. Control cables ICEA S-58-679, Method 1, Table E-2:

    a. When a bare ground is not provided, one of the colored insulated conductors shall be re-identified by stripping the insulation from the entire exposed length or using green tape to cover the entire exposed length.
    b. When used in power applications the colored insulated conductors used as phase and neutral conductors may have to be re-identified with 3 inches of colored tape, per the Table herein, applied at the terminations.

3.03 CIRCUIT IDENTIFICATION

A. Identify power, instrumentation, and control conductor circuits at each termination, and in accessible locations such as handholes, panels, pull boxes, and terminal boxes.

B. Circuits Appearing in Circuit Schedules: Identify using circuit schedule designations. Include source (panel) each conductor originates from.

C. Circuits Not Appearing in Circuit Schedules:

1. Assign circuit name based on device or equipment at load end of circuit.

2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

D. Method:

1. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
2. Cables and Conductors 2 AWG and Larger:

   a. Identify with marker plates or tie-on cable marker tags.
   b. Attach with nylon tie cord.
3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.

B. Do not splice incoming service conductors and branch power distribution conductors 6 AWG and larger, unless specifically indicated or approved by Engineer.

C. Connections and Terminations:

1. Install wire nuts only on solid conductors. Wire nuts are not allowed on stranded conductors.
2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors 12 AWG and smaller.
4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors 4 AWG through 2/0 AWG.
5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors 3/0 AWG and larger.
6. Install uninsulated terminators bolted together on motor circuit conductors 10 AWG and larger.
7. Place no more than one conductor in any single-barrel pressure connection.
8. Install crimp connectors with tools approved by connector manufacturer.
9. Install terminals and connectors acceptable for type of material used.
10. Compression Lugs:

a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
b. Do not use plier type crimpers.

D. Do not use soldered mechanical joints.

E. Splices and Terminations:

1. Feeder and branch power circuits:

a. Device outlet boxes:
1) Twist/screw on type connectors.
b. Junction and pull boxes and wireways:
1) Twist/screw on type connectors for use on No. 8 and smaller wire.
2) Compression, mechanical screw or terminal block or terminal strip type connectors for use on No. 6 AWG and larger wire.
c. Handholes:
1) Twist/screw on type connectors pre-filled with epoxy for use on No. 8 AWG and smaller wire.
2) Watertight compression or mechanical screw type connectors for use on No. 6 AWG and larger wire.

2. Control circuits:

a. Junction and pull boxes: Terminal block type connector.
b. Handholes: Twist/screw on type connectors pre-filled with epoxy.
c. Control panels: Terminal block or strips provided within the equipment or field installed within the equipment by the Contractor.

3. Instrumentation circuits can be spliced where field conditions dictate and written permission is obtained from the Engineer.

a. Maintain electrical continuity of the shield when splicing twisted shielded conductors.
b. Junction and pull boxes: Terminal block type connector.
c. Control panels and motor control centers: Terminal block or strip provided within the equipment or field installed within the equipment by the Contractor.

4. Non-insulated compression and mechanical screw type connectors shall be insulated with tape or hot or cold shrink type insulation to the insulation level of the conductors.

F. Cap spare conductors with UL listed end caps.

G. Cabinets and Panels:

1. Remove surplus wire, bridle and secure.
2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.

H. Control and Instrumentation Wiring:

1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
4. Where connections of cables installed under this section are to be made under Section 40 90 00, Instrumentation and Control for Process Systems, leave pigtails of adequate length for bundled connections.
5. Cable Protection:

    a. Under Infinite Access Floors: May install without bundling.
    b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under floor or grouped into bundles at least 1/2 inch in diameter.
    c. Maintain integrity of shielding of instrumentation cables.
    d. Ensure grounds do not occur because of damage to jacket over shield.

I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

END OF SECTION

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Related Specification Sections include but are not limited to:

1. Section 26 05 02 - Basic Electrical Requirements.
2. Section 26 05 04 - Basic Electrical Materials and Methods.
3. Section 26 05 05 - Conductors.
4. Section 26 05 33 - Raceways and Boxes.
5. Section 26 08 00 - Commissioning of Electrical Systems.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
2. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC).

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product data for the following:
      1) Ground conductors.
      2) Exothermic weld connectors.
      3) Mechanical connectors.
      4) Compression connectors.
      5) Specialty tools.

1.04 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.01 GROUND CONDUCTORS

A. As specified in Section 26 05 05, Conductors.

2.02 CONNECTORS

A. Exothermic Weld Type:

1. Outdoor Weld: Suitable for exposure to elements or direct burial.
2. Indoor Weld: Utilize low-smoke, low-emission process.
3. Manufacturers:
   a. Erico Products, Inc. Cadweld and Cadweld Exolon.
   b. Thermoweld.
   c. Or equal.

B. Compression Type:

1. Compress-deforming type; wrought copper extrusion material.
2. Single indentation for conductors 6 AWG and smaller.
3. Double indentation with extended barrel for conductors 4 AWG and larger.
4. Barrels prefilled with oxide-inhibiting and antiseizing compound and sealed.
5. Manufacturers:
   a. Burndy Corp.; Hyground Irreversible Compression.
   b. Thomas and Betts Co.
   c. ILSCO.
   d. Or equal.

C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.

1. Manufacturers:
   a. Burndy Corp.
   b. Thomas and Betts Co.or equal.
   c. Or equal.

PART 3 EXECUTION

3.01 GENERAL

A. Install products in accordance with manufacturer's instructions.

B. Remove paint, rust, or other non-conducting material from contact surfaces before making ground connections. After connection, apply manufacturers approved touch-up paint to protect metallic surface from corrosion.

C. Where ground conductors pass through floor slabs or building walls provide nonmetallic sleeves and install sleeve per the Greenbook, the Whitebook, and Section 01 73 20 – Openings and Penetrations in Construction.

1. Seal the sleeve interior to stop water penetration.

CI. Grounding shall be in compliance with NFPA 70 and IEEE C2.

CII. Ground electrical service neutral at service entrance equipment with grounding electrode conductor to grounding electrode system.

CIII. Ground each separately derived system neutral with common grounding electrode conductor to grounding electrode system.

CIV. Bond together all grounding electrodes that are present at each building or structure served to form one common grounding electrode system.

CV. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.

CVI. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.

CVII. Shielded Instrumentation Cables:

1. Ground shield to ground bus at power supply for analog signal.
2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
3. Do not ground instrumentation cable shield at more than one point.

CVIII. Size grounding conductors and bonding jumpers in accordance with NFPA 70, Article 250, except where larger sizes are indicated on the Drawings.

3.02 WIRE CONNECTIONS

A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.

B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

C. Connect ground conductors to raceway grounding bushings.

D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.

E. Connect enclosure of equipment containing ground bus to that bus.

F. Bolt connections to equipment ground bus.

G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

I. Metallic Equipment Enclosures: Use furnished ground lug; if none furnished, tap equipment housing and install solderless terminal connected to box with machine screw. For circuits greater than 20 amps use minimum 5/16-inch diameter bolt.

3.03 CONNECTIONS

A. General:

1. Abovegrade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
2. Belowgrade Connections: Install exothermic weld or compression type connectors.
3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
4. Notify Engineer prior to backfilling ground connections.

B. Exothermic Weld Type:

1. Wire brush or file contact point to bare metal surface.
2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
3. Avoid using badly worn molds.
4. Mold to be completely filled with metal when making welds.
5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

C. Compression Type:

1. Install in accordance with connector manufacturer's recommendations.
2. Install connectors of proper size for grounding conductors and ground rods specified.
3. Install using connector manufacturer's compression tool having proper sized dies and operate per manufacturer's instructions.

D. Mechanical Type:

1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.

2. Install in accordance with connector manufacturer's recommendations.
3. Do not conceal mechanical connections.

3.04 METAL STRUCTURE GROUNDING

A. Bond metal sheathing and exposed metal vertical structural elements to grounding system.

B. Bond electrical equipment supported by metal platforms to the platforms.

C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

3.05 HANDHOLE GROUNDING

A. Install one ground rod inside each handhole larger than 24-inch by 24-inch inside dimensions.

B. Ground Rod Floor Protrusion: 4 inches to 6 inches above floor.

C. Make connections of grounding conductors fully visible and accessible.

D. Connect all noncurrent-carrying metal parts, and any metallic raceway grounding bushings to ground rod with 6 AWG copper conductor.

3.06 TRANSFORMER GROUNDING

A. Bond neutrals of transformers within buildings to system ground network, and to any additional indicated grounding electrodes.

B. Bond neutrals of substation transformers to substation grounding grid and system grounding network.

C. Bond neutrals of pad-mounted transformers to four locally driven ground rods and buried ground wire encircling transformer and system ground network.

3.07 SURGE PROTECTION EQUIPMENT GROUNDING

A. Connect surge arrestor ground terminals to equipment ground bus.

END OF SECTION

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SECTION 26 05 33
RACEWAY AND BOXES

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Related Specification Sections include but are not limited to:

1. Section 26 05 02 - Basic Electrical Requirements.
2. Section 26 05 04 - Basic Electrical Materials and Methods.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): HB, Standard Specifications for Highway Bridges.
2. ASTM International (ASTM):
   a. A123/123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
   b. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   d. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
   e. D149, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
3. Telecommunications Industry Association (TIA): 569B, Commercial Building Standard for Telecommunications Pathways and Spaces.
4. National Electrical Contractor’s Association, Inc. (NECA): Installation standards.
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. C80.1, Electrical Rigid Steel Conduit (ERSC).
   c. C80.3, Steel Electrical Metallic Tubing (EMT).
   d. C80.5, Electrical Rigid Aluminum Conduit (ERAC).
   e. C80.6, Electrical Intermediate Metal Conduit (EIMC).
   f. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
   g. TC 2, Electrical Polyvinyl Chloride (PVC) Conduit.
   h. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
   i. TC 6, Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation.

j. TC 14, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
k. VE 1, Metallic Cable Tray Systems.

6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. Underwriters Laboratories Inc. (UL):
   a. 1, Standard for Safety for Flexible Metal Conduit.
   b. 5, Standard for Safety for Surface Metal Raceways and Fittings.
   c. 6, Standard for Safety for Electrical Rigid Metal Conduit – Steel.
   d. 6A, Standard for Safety for Electrical Rigid Metal Conduit – Aluminum, Red Brass and Stainless.
   e. 360, Standard for Safety for Liquid-Tight Flexible Steel Conduit.
   f. 514B, Standard for Safety for Conduit, Tubing, and Cable Fittings.
   g. 651, Standard for Safety for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
   h. 651A, Standard for Safety for Type EB and A Rigid PVC Conduit and HDPE Conduit.
   i. 797, Standard for Safety for Electrical Metallic Tubing – Steel.
   j. 870, Standard for Safety for Wireways, Auxiliary Gutters, and Associated Fittings.
   k. 1242, Standard for Safety for Electrical Intermediate Metal Conduit – Steel.
   l. 1660, Standard for Safety for Liquid-Tight Flexible Nonmetallic Conduit.
   m. 1684, Standard for Safety for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
   n. 2024, Standard for Safety for Optical Fiber and Communication Cable Raceway.

1.03 SUBMITTALS

A. Action Submittals:

1. Manufacturer’s Literature:
   a. Rigid galvanized steel conduit.
   b. PVC Schedule 40 conduit.
   c. PVC Schedule 80 conduit.
   d. PVC-coated rigid galvanized steel conduit, submittal to include copy of manufacturer’s warranty.
   e. Flexible metal, liquid-tight conduit
   f. Flexible, nonmetallic, liquid-tight conduit.
   g. Conduit fittings.
   h. Junction and pull boxes used at or below grade.
   i. Large junction and pull boxes.
   j. Terminal junction boxes.

2. Precast Handholes:
   a. Dimensional drawings and descriptive literature.
   b. Traffic loading calculations.
   c. Accessory information.
3. Equipment and machinery proposed for bending metal conduit.
4. Method for bending PVC conduit less than 30 degrees.
5. Seismic anchorage and bracing drawings and cut sheets.
6. Conduit Layout:
   a. Provide drawings for conduit installations, underground and concealed conduits including, but not limited to ductbanks, under floor slabs, concealed in floor slabs, and concealed in walls.
   b. Provide plan and section showing arrangement and location of conduit and duct bank required for:
      1) Low voltage feeder and branch circuits.
      2) Instrumentation and control systems.
      3) Communications systems.
      4) Empty conduit for future use.
   c. Electronic CAD scale not greater than 1 inch equals 20 feet.

B. Informational Submittals:

1. Component and attachment testing seismic certificate of compliance.
2. Manufacturer's certification of training for PVC-coated rigid galvanized steel conduit installer.

1.04 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

B. PVC-Coated, Rigid Galvanized Steel Conduit Installer: Certified by conduit manufacturer as having received minimum 2 hours of training on installation procedures.

PART 2 PRODUCTS

2.01 CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit (RGS):

1. Meet requirements of NEMA C80.1 and UL 6.
2. Material: Hot-dip galvanized with chromated protective layer.
3. Manufacturers:
   a. Allied Tube and Conduit.
   b. Western Tube and Conduit Corporation.
   c. Wheatland Tube.
   d. Or equal.

B. PVC Schedule 40 Conduit:

1. Meet requirements of NEMA TC 2 and UL 651.
2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.
3. Manufacturers:
   a. Prime Conduit.
   b. Cantex Inc.
   c. Or equal.

C. PVC Schedule 80 Conduit:

1. Meet requirements of NEMA TC 2 and UL 651.
2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.
3. Manufacturers:
   a. Prime Conduit.
   b. Cantex Inc.
   c. Or equal.

D. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of NEMA RN 1
2. Material:
   a. Meet requirements of NEMA C80.1 and UL 6.
   b. Exterior Finish: PVC coating, 40-mil nominal thickness; bond to metal shall have tensile strength greater than PVC.
   c. Interior finish: Urethane coating, 2-mil nominal thickness.
3. Threads: Hot-dipped galvanized and factory coated with urethane.
4. Bendable without damage to interior or exterior coating.
5. Manufacturers:
   a. Ocal by Thomas & Betts.
   b. Robroy Industries.
   c. Or equal.

E. Flexible Metal, Liquid-Tight Conduit:

1. UL 360 listed for 105 degrees C insulated conductors.
2. Material: Galvanized steel with extruded PVC jacket.
3. Manufacturers:
   a. AFC Cable Systems.

b. Anamet, Inc.
c. Electri-Flex Company.
d. Southwire Company.
e. Or equal.

F. Flexible Metal, Nonliquid-Tight Conduit:

1. Meet requirements of UL 1.
2. Material: Galvanized steel.
3. Manufacturers:
   a. AFC Cable Systems.
   b. Anamet, Inc.
   c. Electri-Flex Company.
   d. Southwire Company.
   e. Or equal.

G. Flexible, Nonmetallic, Liquid-Tight Conduit:

1. Material: PVC core with fused flexible PVC jacket.
2. UL 1660 listed for:
   a. Dry Conditions: 80 degrees C insulated conductors.
   b. Wet Conditions: 60 degrees C insulated conductors.
3. Manufacturers and Products:
   a. Carlon; Carflex or X-Flex.
   b. T & B; Xtraflex LTC or EFC.
   c. Or equal.

2.02 FITTINGS

A. Rigid Galvanized Steel and Intermediate Metal Conduit:

1. General:
   a. Meet requirements of UL 514B.
   b. Type: Threaded, galvanized. Set screw and threadless compression fittings not permitted.
2. Bushing:
   a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
   b. Manufacturers and Products:
      1) Appleton; Series BU-I.
      2) O-Z/Gedney; Type HB.
      3) Or equal.
3. Grounding Bushing:
   a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
   b. Manufacturers and Products:
      1) Appleton; Series GIB.
      2) O-Z/Gedney; Type HBLG.
      3) Or equal.

4. Conduit Hub:
   a. Material: Malleable iron with insulated throat with bonding screw.
   b. UL listed for use in wet locations.
   c. Manufacturers and Products:
      1) Appleton, Series HUB-B.
      2) O-Z/Gedney; Series CH.
      3) Meyers; ST Series.
      4) Or equal.
5. Conduit Bodies:
   a. Sized as required by NFPA 70.
   b. Manufacturers and Products (For Normal Conditions):
      1) Appleton; Form 35 threaded unilets.
      2) Crouse-Hinds; Form 7 or Form 8 threaded condulets.
      3) Killark; Series O electrolets.
      4) Thomas & Betts; Form 7 or Form 8.
      5) Or equal.
   c. Manufacturers (For Hazardous Locations):
      1) Appleton.
      2) Crouse-Hinds.
      3) Killark.
      4) Or equal.
6. Couplings: As supplied by conduit manufacturer.
7. Unions:
   a. Concrete tight, hot-dip galvanized malleable iron.
   b. Manufacturers and Products:
      1) Appleton; Series SCC bolt-on coupling or Series EC three-piece union.
      2) O-Z/Gedney; Type SSP split coupling or Type 4 Series, three-piece coupling.
      3) Or equal.
8. Conduit Sealing Fitting:
   a. Manufacturers and Products:
      1) Appleton; Type EYF, EYM, or ESU.
      2) Crouse-Hinds; Type EYS or EZS.
      3) Killark; Type EY or Type EYS.
      4) Or equal.
9. Drain Seal:
   a. Manufacturers and Products:
      1) Appleton; Type EYD.
      2) Crouse-Hinds; Type EYD or Type EZD.
      3) Or equal.
10. Drain/Breather Fitting:
    a. Manufacturers and Products:
       1) Appleton; Type ECDB.
       2) Crouse-Hinds; ECD.
       3) Or equal.
11. Expansion Fitting:
    a. Manufacturers and Products:

1) Deflection/Expansion Movement:
   a) Appleton; Type DF.
   b) Crouse-Hinds; Type XD.
   c) Or approved equal.
2) Expansion Movement Only:
   a) Appleton; Type XJ.
   b) Crouse-Hinds; Type XJ.
   c) Thomas & Betts; XJG-TP.
   d) Or approved equal.

12. Cable Sealing Fitting:
    a. To form watertight nonslip cord or cable connection to conduit.
    b. For Conductors with OD of 1/2 inch or Less: Neoprene bushing at connector entry.
    c. Manufacturers and Products:
       1) Appleton; CG-S.
       2) Crouse-Hinds; CGBS.
       3) Or approved equal.

B. PVC Conduit and Tubing:

1. Meet requirements of NEMA TC 3.
2. Type: PVC, slip-on.

C. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of UL 514B.
2. Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.
3. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer.
4. Finish: 40-mil PVC exterior, 2-mil urethane interior.
5. Overlapping pressure-sealing sleeves.
6. Conduit Hangers, Attachments, and Accessories: PVC-coated.
7. Manufacturers:
   a. Robroy Industries.
   b. Ocal.
   c. Or approved equal.
8. Expansion Fitting:
   a. Manufacturer and Product: Ocal; OCAL-BLUE XJG.
   b. Or approved equal.

D. Flexible Metal, Liquid-Tight Conduit:

1. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
2. Insulated throat and sealing O-rings.
3. Manufacturers and Products:
   a. Thomas & Betts; Series 5331.
   b. O-Z/Gedney; Series 4Q.

c. Or approved equal.

E. Flexible Metal, Nonliquid-Tight Conduit:

1. Meet requirements of UL 514B.
2. Body: Galvanized steel or malleable iron.
3. Throat: Nylon insulated.
4. 1-1/4-Inch Conduit and Smaller: One screw body.
5. 1-1/2-Inch Conduit and Larger: Two screw body.
6. Manufacturer and Product: Appleton; Series 7400 or equal.

F. Flexible, Nonmetallic, Liquid-Tight Conduit:

1. Meet requirements of UL 514B.
2. Type: High strength plastic body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.
3. Body/compression nut (gland) design to ensure high mechanical pullout strength and watertight seal.
4. Manufacturers and Products:
   a. Carlon; Type LT.
   b. O-Z/Gedney; Type 4Q-P.
   c. Thomas & Betts; Series 6300.
   d. Or equal.

G. Flexible Coupling, Hazardous Locations:

1. Approved for use in atmosphere involved.
2. Rating: Watertight and UL listed for use in Class I, Division 1 and 2 areas.
3. Outer bronze braid and an insulating liner.
4. Conductivity equal to a similar length of rigid metal conduit.
5. Manufacturers and Products:
   a. Crouse-Hinds; Type ECGJH or Type ECLK.
   b. Appleton; EXGJH or EXLK.
      Or equal.

H. Watertight Entrance Seal Device:

1. New Construction:
   a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
   b. Manufacturer and Product: O-Z/Gedney; Type FSK or Type WSK, as required.
      1) Or equal.
2. Cored-Hole Application:
   a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.
   b. Manufacturer and Product: O-Z/Gedney; Series CSM or equal.

2.03 JUNCTION AND PULL BOXES

A. Outlet Box Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.

B. Conduit Bodies Used as Junction Boxes: As specified under Article Fittings.

C. Large Sheet Steel Box:

1. NEMA 250, Type 1.
2. Box: Code-gauge, galvanized steel.
3. Cover: Full access, screw type.
4. Machine Screws: Corrosion-resistant.

D. Large Cast Metal Box:

1. NEMA 250, Type 4.
2. Box: Cast malleable iron or ferrous metal, electrogalvanized finished, with drilled and tapped conduit entrances and exterior mounting lugs.
3. Cover: Hinged with clamps.
4. Gasket: Neoprene.
5. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
6. Manufacturers and Products, Surface Mounted Nonhinged Type:
   a. Crouse-Hinds; Series W.
   b. O-Z/Gedney; Series Y.
   c. Or equal.
7. Manufacturer and Product, Surface Mounted, Hinged Type: O-Z/Gedney; Series YW.
   a. Or equal.
8. Manufacturers and Products, Recessed Type:
   a. Crouse-Hinds; Type WJBF.
   b. O-Z/Gedney; Series YR.
   c. O-Z/Gedney; Series YS-A, YL-A.
   d. Killark.
   e. Or equal.

E. Large Stainless Steel Box:

1. NEMA 250 Type 4X.
2. Box: 14-gauge, ASTM A240/A240M, Type 304 stainless steel with white enamel painted interior mounting panel.
3. Cover: Hinged with clamps.
4. Hardware and Machine Screws: ASTM A167, Type 304 stainless steel.
5. Manufacturers:
   a. Hoffman Engineering Co.
   b. Robroy Industries.
   c. Wiegman.
   d. Or equal.

F. NEMA 7 Rated:

1. Cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
2. Drilled and tapped openings or tapered threaded hub.
3. Cover bolted-down with stainless steel bolts or threaded cover with neoprene gasket.
4. External mounting flanges.
5. Grounding lug.
6. Accessories: 40 MIL PVC exterior coating and 2 MIL urethane interior coating.

G. Concrete Box, Nontraffic Areas:

1. Box: Reinforced, cast concrete with extension.
2. Cover: Steel diamond plate with locking bolts.
3. Cover Marking: ELECTRICAL, TELEPHONE, or as shown.
4. Size: 10 inches by 17 inches, minimum.
5. Manufacturers and Products:
   a. Utility Vault Co.; Series 36-1017.
   b. Christy, Concrete Products, Inc.; N9.
   c. Quazite; “PG” Style.
   d. Or equal.

2.04 TERMINAL JUNCTION BOX

A. Cover: Hinged, unless otherwise shown.

B. Interior Finish: Paint with white enamel or lacquer.

C. Terminal Blocks:

1. Separate connection point for each conductor entering or leaving box.
2. Spare Terminal Points: 25 percent, minimum.

2.05 ACCESSORIES

A. Duct Bank Spacers:

1. Modular Type:
   a. Nonmetallic, interlocking, for multiple conduit sizes.
   b. Suitable for all types of conduit.
   c. Manufacturers:
      1) Underground Device, Inc.
      2) Carlon.
      3) Or equal.
2. Template Type:
   a. Nonmetallic, custom made one-piece spacers.
   b. Suitable for all types of conduit.

c. Material: HDPE or polypropylene, 1/2-inch minimum thickness.
d. Conduit openings cut 1 inch larger than conduit outside diameter.
e. Additional openings for stake-down, rebar, and concrete flow through as required.
f. Manufacturer and Product: SP Products; Quik Duct or equal.

B. Identification Devices:

1. Raceway Tags:
   a. Material: Permanent, polyethylen.
   b. Shape: Round.
   c. Raceway Designation: Pressure stamped, embossed, or engraved.
   d. Tags relying on adhesives or taped-on markers not permitted.

2. Warning Tape:
   a. Material: Polyethylene, 4-mil gauge with detectable strip.
   b. Color: Red.
   c. Width: Minimum 3 inches.
   d. Designation: Warning on tape that electric circuit is located below tape.
   e. Identifying Letters: Minimum 1-inch-high permanent black lettering imprinted continuously over entire length.
   f. Manufacturers and Products:
      1) Panduit; Type HTDU.
      2) Reef Industries; Terra Tape.
      3) Or equal.
3. Buried Raceway Marker:
   a. Material: Sheet bronze, consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction.
   b. Designation: Engrave to depth of 3/32 inch; ELECTRIC CABLES, in letters 1/4-inch high.
   c. Minimum Dimension: 1/4 inch thick, 10 inches long, and 3/4 inch wide.

C. Raceway Coating: Clean and paint outdoor conduits to match surrounding surface.

D. Heat Shrinkable Tubing:

1. Material: Heat-shrinkable, cross-linked polyolefin.
2. Semi-flexible with meltable adhesive inner liner.
3. Color: Black.
4. Manufacturers:
   a. Raychem.
   b. 3M.
   c. Or equal.

E. Wraparound Duct Band:

1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.
2. Width: 50 mm minimum.
3. Manufacturer and Product: Raychem; Type TWDB.
4. Or equal.

PART 3 EXECUTION

3.01 GENERAL

A. Conduit and tubing sizes shown are based on use of copper conductors. Reference Section 26 05 05, Conductors, concerning conduit sizing for aluminum conductors.

B. Comply with NECA Installation Standards.

C. Crushed or deformed raceways not permitted.

D. Maintain raceway entirely free of obstructions and moisture.

E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.

F. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.

G. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.

H. Group raceways installed in same area.

I. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.

J. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.

K. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.

L. Block Walls: Do not install raceways in same horizontal course or vertical cell with reinforcing steel.

M. Install watertight fittings in outdoor, underground, or wet locations.

N. Paint threads and cut ends, before assembly of fittings, galvanized conduit, PVC-coated galvanized conduit, or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.

O. Metal conduit shall be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.

P. Do not install raceways in concrete equipment pads, foundations, or beams without Engineer approval.

Q. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.

R. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.

S. Install conduits for fiber optic cables, telephone cables, and Category 6 data cables in strict conformance with the requirements of TIA 569B.

T. Conduit runs are shown diagrammatically on the Drawings. Contractor shall make field adjustments as necessary to construct a complete system, avoid conflicts with existing and new utilities, provide sufficient clearances, and provide sufficient access.

1. Additional conduit length required to achieve field routing shall be at no additional cost.

U. Supports, pull boxes, junction boxes, and other ancillary equipment are not usually shown. Provide pull boxes and junction boxes where shown. Provide additional pull boxes and junction boxes as required to permit pulling of wires without damage to the conductors or insulation.

1. Additional supports, pull boxes, junction boxes, or other ancillary equipment not shown on the Drawings shall be at no additional cost.

3.02 CONDUIT SEALS:

A. Installed in conduit systems located in hazardous areas as required by the NFPA 70.

1. Rooms designated as corrosive on the drawings.
2. In each conduit entering or leaving the area.
3. In each conduit entering or leaving the following types electrical equipment enclosures in the area.
4. If not shown on the Drawings, Contractor shall provide and install conduits seals as required by NFPA 70.

B. Fill plug and drain shall be accessible.

C. Pour the conduit seals in a two-step process.

1. Pour the seal and leave cover off.
2. After seal is dry, inspect for proper sealing, install cover and mark (for example, paint or permanent marker) as complete.

3.03 REUSE OF EXISTING CONDUITS

A. Where Drawings indicate existing conduits may be reused, they may be reused only where they meet the following criteria.

1. Conduit is in useable condition with no deformation, corrosion, or damage to exterior surface.
2. Conduit is sized per the NEC.
3. Conduit is of the type specified in Contract Documents.
4. Conduit is supported as specified in Contract Documents.

B. Conduit shall be reamed with wire brush, then with a mandrel approximately 1/4 inch smaller than raceway inside diameter then cleaned prior to pulling new conductors.

3.04 INSTALLATION IN CAST-IN-PLACE STRUCTURAL CONCRETE

A. Minimum Cover: 2 inches, including fittings.

B. Conduit placement shall not require changes in reinforcing steel location or configuration.

C. Provide nonmetallic support during placement of concrete to ensure raceways remain in position.

D. Conduit larger than 1 inch shall not be embedded in concrete slabs, walls, foundations, columns, or beams unless approved by Engineer.

E. Slabs and Walls (Requires Engineer Approval):

1. Trade size of conduit not to exceed one-fourth of slab or wall thickness.
2. Install within middle two-fourths of slab or wall.
3. Separate conduit less than 2-inch trade size by a minimum ten times conduit trade size, center-to-center, unless otherwise shown.
4. Separate conduit 2-inch and greater trade size by a minimum eight times conduit trade size, center-to-center, unless otherwise shown.
5. Cross conduit at an angle greater than 45 degrees, with minimum separation of 1 inch.
6. Separate conduit by a minimum six times the outside dimension of expansion/deflection fittings at expansion joints.
7. Conduit shall not be installed below the maximum water surface elevation in walls of water holding structures.

F. Columns and Beams (Requires Engineer Approval):

1. Trade size of conduit not to exceed one-fourth of beam thickness.
2. Conduit cross-sectional area not to exceed 4 percent of beam or column cross section.

3.05 CONDUIT APPLICATION

A. Diameter: Minimum 1/2 inch.

B. Exterior, Exposed:

1. PVC-coated rigid galvanized steel.

C. Interior, Exposed:

1. Rigid galvanized steel.

D. Aboveground, Embedded in Concrete Walls, Ceilings, or Floors:

1. PVC Schedule 40.

E. Direct Earth Burial:

1. PVC Schedule 80

F. Concrete-Encased Ductbank:

1. PVC Schedule 40.

G. Transition from Underground or Concrete Embedded to Exposed: PVC-coated rigid steel conduit.

H. Under Equipment Mounting Pads: PVC Schedule 40 conduit.

I. Corrosive Areas:

1. PVC-coated rigid galvanized steel

3.06 FLEXIBLE CONNECTIONS

A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other locations approved by Engineer where flexible connection is required to minimize vibration:

1. Conduit Size 4 Inches or Less: Flexible, liquid-tight conduit.
2. Conduit Size Over 4 Inches: Nonflexible.
3. Wet or Corrosive Areas: Flexible, nonmetallic or flexible metal liquid-tight.
4. Dry Areas: Flexible, metallic liquid-tight.
5. Hazardous Areas: Flexible coupling suitable for Class I, Division 1 and 2 areas.

B. Suspended Lighting Fixtures in Dry Areas: Flexible steel, nonliquid-tight conduit.

C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.

D. Flexible Conduit Length: 18 inches minimum, 60 inches maximum; sufficient to allow movement or adjustment of equipment.

3.07 PENETRATIONS

A. Make at right angles, unless otherwise shown.

B. Notching or penetration of structural members, including footings and beams, not permitted.

C. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating as specified in Section 26 05 04, Basic Electrical Materials and Methods.

D. Apply heat shrinkable tubing or single layer of wraparound duct band to metallic conduit protruding through concrete floor slabs to a point 2 inches above and 2 inches below concrete surface.

E. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack, or use watertight seal device.

F. Entering Structures:

1. General: Seal raceway at first box or outlet with oakum or expandable plastic compound to prevent entrance of gases or liquids from one area to another.

2. Concrete Roof or Membrane Waterproofed Wall or Floor:
   a. Provide a watertight seal.
   b. Without Concrete Encasement: Install watertight entrance seal device on each side.
   c. With Concrete Encasement: Install watertight entrance seal device on accessible side.
   d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
   e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.
3. Corrosive-Sensitive Areas:
   a. Seal conduit passing through chlorine and ammonia room walls.
   b. Seal conduit entering equipment panel boards and field panels containing electronic equipment.
   c. Seal penetration with Type 5 sealant.
4. Existing or Precast Wall (Underground): Core drill wall and install watertight entrance seal device.
5. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):

a. Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
b. Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint, on each side.

6. Handholes:
   a. Metallic Raceways: Provide insulated grounding bushings.
   b. Nonmetallic Raceways: Provide bell ends flush with wall.
   c. Install such that raceways enter as near as possible to one end of wall, unless otherwise shown.

3.08 SUPPORT

A. Support from structural members only, at intervals not exceeding NFPA 70 requirements. Do not exceed 8 feet in any application. Do not support from piping, pipe supports, or other raceways.

B. Contractor shall provide and install raceway supports as required in addition to those shown on the Drawings.

C. Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit, allow 20 percent extra space for future conduit.

D. Application/Type of Conduit Strap:

1. Aluminum Conduit: Aluminum or stainless steel.
2. Rigid Steel or EMT Conduit: Zinc coated steel, pregalvanized steel or malleable iron.
3. PVC-Coated Rigid Steel Conduit: PVC-coated metal.
4. Nonmetallic Conduit: Nonmetallic or PVC-coated metal.

E. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:

1. Wood: Wood screws.
2. Hollow Masonry Units: Toggle bolts.
3. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
4. Steelwork: Machine screws.
5. Location/Type of Hardware:
   a. Dry, Noncorrosive Areas: Galvanized.
   b. Wet, Noncorrosive Areas: Stainless steel.
   c. Corrosive Areas: Stainless steel.

F. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

G. Support aluminum conduit on concrete surfaces with stainless steel or nonmetallic spacers, or aluminum or nonmetallic framing channel.

3.09 BENDS

A. Install concealed raceways with a minimum of bends in the shortest practical distance.

B. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.

C. Install with symmetrical bends or cast metal fittings.

D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.

E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.

F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.

G. PVC Conduit:

1. Bends 30 Degrees and Larger: Provide factory-made elbows.
2. 90-Degree Bends: Provide rigid steel elbows, PVC-coated where direct buried.
3. Use manufacturer’s recommended method for forming smaller bends.

H. Do not exceed 270 degrees of bends in any single conduit run. Reset the bends by terminating to a condulet (when allowed by NEC) or pull box.

I. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.10 EXPANSION/DEFLECTION FITTINGS

A. Provide on raceways at structural expansion joints and in long tangential runs.

B. Provide expansion/deflection joints for 50 degrees F maximum temperature variation.

C. Install in accordance with manufacturer’s instructions.

3.11 PVC CONDUIT

A. Solvent Welding:

1. Apply manufacturer recommended solvent to joints.
2. Install in order that joint is watertight.

B. Adapters:

1. PVC to Metallic Fittings: PVC terminal type.
2. PVC to Rigid Metal Conduit or IMC: PVC female adapter.

C. Belled-End Conduit: Bevel unbelled end of joint prior to joining.

3.12 PVC-COATED RIGID STEEL AND RIGID ALUMINUM CONDUIT

A. Install in accordance with manufacturer's instructions.

B. Tools and equipment used in cutting, bending, threading and installation of PVC-coated rigid conduit shall be designed to limit damage to PVC coating.

C. Provide PVC boot to cover exposed threading.

3.13 TERMINATION AT ENCLOSURES

A. Cast Metal Enclosure: Install manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.

B. Sheet Metal Boxes, Cabinets, and Enclosures:

1. General:
   a. Install insulated bushing on ends of conduit where grounding is not required.
   b. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
   c. Utilize sealing locknuts or threaded hubs on sides and bottom of NEMA 3R and NEMA 12 enclosures.
   d. Terminate conduits at threaded hubs at the tops of NEMA 3R and NEMA 12 boxes and enclosures.
   e. Terminate conduits at threaded conduit hubs at NEMA 4 and NEMA 4X boxes and enclosures.
2. Rigid Galvanized Conduit:
   a. Provide one lock nut each on inside and outside of enclosure.
   b. Install grounding bushing at source enclosure.
   c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad.
3. Electric Metallic Tubing: Provide gland compression, insulated connectors.
4. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.
5. Flexible, Nonmetallic Conduit: Provide nonmetallic, liquid-tight strain relief connectors.
6. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.
7. PVC Schedule 40 Conduit: Provide PVC terminal adapter with lock nut, except where threaded hubs required above.

C. Free-Standing Enclosures:

1. Terminate metal conduit entering bottom with grounding bushing; provide grounding jumper extending to equipment ground bus or grounding pad.
2. Terminate PVC conduit entering bottom with bell end fittings.

3.14 UNDERGROUND RACEWAYS

A. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one handhole, or pull box to the next, or from a high point between them, depending on surface contour.

B. Cover: Maintain minimum 2-foot cover above concrete encasement, unless otherwise shown.

C. Make routing changes as necessary to avoid obstructions or conflicts.

D. Couplings: In multiple conduit runs, stagger so couplings in adjacent runs are not in same transverse line.

E. Union type fittings not permitted.

F. Spacers:

1. Provide preformed, nonmetallic spacers designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.
2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.

G. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.

H. Transition from Underground to Exposed: Rigid galvanized steel PVC-coated rigid steel conduit.

I. Installation with Other Piping Systems:

1. Crossings: Maintain minimum 12-inch vertical separation.
2. Parallel Runs: Maintain minimum 12-inch separation.
3. Installation over valves or couplings not permitted.

J. Metallic Raceway Coating: Along entire length, clean and paint to match surrounding surface.

K. Provide expansion fittings that allow minimum of 4 inches of movement in vertical conduit runs from underground where exposed conduit will be fastened to or will enter building or structure.

L. Provide expansion/deflection fittings in conduit runs that exit building or structure belowgrade. Conduit from building wall to fitting shall be PVC-coated rigid steel.

M. Excavation:

1. Trench Excavation:
   a. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.
      1) Support existing utility lines and yard piping where proposed work crosses at a lower elevation.
         a) Stabilize excavation to prevent undermining of existing utility and yard piping.
2. Open trench outside buildings, units, and structures:
   a. No more than the distance between two structures, units, or 300 LF, whichever is less.
   b. Field adjust limitations as weather conditions dictate.
3. Trenching within buildings, units, or structures:
   a. No more than 100 LF at any one time.
4. Any trench or portion of trench, which is opened and remains idle for seven calendar days, or longer, as determined by the Owner, may be directed to be immediately refilled, without completion of work, at no additional cost to Owner.
   a. Said trench may not be reopened until Owner is satisfied that work associated with trench will be prosecuted with dispatch.
5. Observe following trenching criteria:
   a. Trench size:
      1) Excavate width to accommodate free working space.
      2) Maximum trench width at top of pipe or conduit may not exceed outside diameter of utility service by more than the following dimensions:

OVERALL DIAMETER OF UTILITY SERVICE	EXCESS DIMENSION
33 IN and less	18 IN
more than 33 IN	24 IN

      3) Cut trench walls vertically from bottom of trench to 1 FT above top of pipe, conduit, or utility service.
      4) Keep trenches free of surface water runoff.
         a) Include cost in Bid.
         b) No separate payment for surface water runoff pumping will be made.
6. Trenching for Electrical Installations:
   a. Observe the preceding Trench Excavation paragraph in PART 3 of this Specification Section.
   b. Modify for electrical installations as follows:

1) Open no more than 600 LF of trench in exterior locations for trenches more than 12 IN but not more than 30 IN wide.
2) Any length of trench may be opened in exterior locations for trenches which are 12 IN wide or less.
3) Do not over excavate trench.
4) Cut trenches for electrical runs with minimum 30 IN cover, unless otherwise specified or shown on Drawings.

N. Backfill:

1. Material:
   a. Free of rock cobbles, roots, sod or other organic matter, and frozen material.
   b. Moisture content at time of placement: ± 3 PCT of optimum moisture content as specified in accordance with ASTM D698.
2. Do not backfill until tests to be performed on system show system is in full compliance with specified requirements and until inspected by Engineer.
3. Carefully Compacted Backfill:
   a. Furnish where indicated on Drawings, specified for trench embedment conditions and for compacted backfill conditions up to 12 IN above top of pipe or conduit.
   b. Comply with the following:
      1) Place backfill in lifts not exceeding 8 IN (loose thickness).
      2) Hand place, shovel slice, and pneumatically tamp all carefully compacted backfill.
      3) Observe specific manufacturer's recommendations regarding backfilling and compaction.
      4) Compact each lift to specified requirements.
4. Common Trench Backfill:
   a. Perform in accordance with the following:
      1) Place backfill in lift thicknesses capable of being compacted to densities specified.
      2) Observe specific manufacturer's recommendations regarding backfilling and compaction.
      3) Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.

O. Compaction:

1. General:
   a. Place and assure bedding, backfill, and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.
   b. In no case shall degree of compaction below minimum compactions specified be accepted.
2. Compaction Requirements:

a. Unless noted otherwise on Drawings or more stringently by other Specification Sections, comply with following minimum trench compaction criteria.

1) Carefully compacted backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
All applicable areas	Cohesive soils	95 PCT of maximum dry density by ASTM D698
	Cohesionless soils	90 PCT relative density by ASTM D4253 and ASTM D4254

b. Common trench backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
Under pavements, roadways, surfaces within highway right-of-ways	Cohesive soils	95 PCT of maximum dry density by ASTM D698
	Cohesionless soils	90 PCT of relative density by ASTM D4253 and ASTM D4254

3.15 JUNCTION AND PULL BOXES

A. General:

1. Install plumb and level.
2. Installed boxes shall be accessible.
3. Do not install on finished surfaces.
4. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.
5. Use conduit bodies as junction and pull boxes where no splices are required and allowed by applicable codes.
6. Install pull boxes where necessary in raceway system to facilitate conductor installation.
7. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
8. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.
9. When shown on the Drawings but no size is provided, Contractor shall size junction and pull boxes per NFPA 70.

B. Flush Mounted:

1. Install with concealed conduit.
2. Holes in surrounding surface shall be no larger than required to receive box.
3. Make edges of boxes flush with final surface.

C. Mounting Hardware:

1. Noncorrosive Dry Areas: Galvanized.
2. Noncorrosive Wet Areas: Stainless steel.
3. Corrosive Areas: Stainless steel.

D. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.
2. Install bar hangers in frame construction or fasten boxes directly as follows:
   a. Wood: Wood screws.
   b. Concrete or Brick: Bolts and expansion shields.
   c. Hollow Masonry Units: Toggle bolts.
   d. Steelwork: Machine screws.
3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
4. Boxes embedded in concrete or masonry need not be additionally supported.

E. At or Below Grade:

1. Install boxes for below grade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.
2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.
3. Obtain Engineer's written acceptance prior to installation in paved areas, roadways, or walkways.
4. Use boxes and covers suitable to support anticipated weights.

F. Install Drain/breather fittings in NEMA 250 Type 4 and Type 4X enclosures.

G. Permitted usage:

1. NEMA 4 enclosure:
   a. Pull or junction box surface mounted in areas designated as wet.
2. NEMA 4X metallic enclosure:
   a. Pull or junction box surface mounted in areas designated as wet and/or corrosive.
3. NEMA 4X non-metallic enclosure:
   a. Pull or junction box surfaced mounted in areas designated as wet and/or highly corrosive.
4. NEMA 7 enclosure:
   a. Pull or junction box surface mounted in areas designated as Class I hazardous.
      1) Provide PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.
5. NEMA 12 enclosure:

a. Pull or junction box surface mounted in areas designated as dry.

3.16 HANDHOLES

A. Do not install until final raceway grading has been determined.

B. Install such that raceway enters at nearly right angle and as near as possible to end of wall, unless otherwise shown.

C. Grounding: As specified in Section 26 05 26, Grounding and Bonding for Electrical Systems.

D. Identification: Field stamp covers with handhole number as shown. Stamped numbers to be 1-inch minimum height.

3.17 EMPTY RACEWAYS

A. Provide permanent, removable cap over each end.

B. Provide PVC plug with pull tab for underground raceways with end bells.

C. Provide nylon pull cord.

D. Identify, as specified in Article Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

3.18 IDENTIFICATION DEVICES

A. Raceway Tags:

1. Identify origin and destination.
2. For exposed raceways, install tags at each terminus, near midpoint, and at minimum intervals of every 50 feet, whether in ceiling space or surface mounted.
3. Install tags at each terminus for concealed raceways.
4. Provide nylon strap for attachment.

B. Warning Tape: Install approximately 12 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of run.

C. Buried Raceway Marker:

1. Install at grade to indicate direction of underground raceway.
2. Install at bends and at intervals not exceeding 100 feet in straight runs.
3. Embed and secure to top of concrete base, sized 14 inches long, 6 inches wide, and 8 inches deep; top set flush with finished grade.

3.19 PROTECTION OF INSTALLED WORK

A. Protect products from effects of moisture, corrosion, and physical damage during construction.

B. Provide and maintain manufactured watertight and dust-tight seals over conduit openings during construction.

C. Touch up painted conduit threads after assembly to cover nicks or scars.

D. Touch up coating damage to PVC-coated conduit with patching compound approved by manufacturer. Compound shall be kept refrigerated according to manufacturers' instructions until time of use.

END OF SECTION

SECTION 26 05 48
ELECTRICAL SEISMIC RESTRAINT SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. The design and installation of seismic bracing and anchorage required for electrical equipment, conduit, cable tray, and bus ducts.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Civil Engineers (ASCE):
   a. 7, Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
2. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A307, Standard Specification Carbon Steel Bolts, Studs, and Threaded Rod, 60,000 psi Tensile Strength.
   c. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   d. A588/A588M, Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance.
   e. A992/A992M, Standard Specification for Structural Steel Shapes.
   f. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.

1.03 SYSTEM DESCRIPTION

A. Contractor is responsible for design and installation of seismic bracing and anchorage systems.

B. Description of Systems:

1. Transverse and longitudinal bracing for seismic forces on suspended electrical systems including conduit, cable tray, bus duct, and equipment.
2. Anchorage of floor and roof mounted electrical equipment.

C. Seismic Design Requirements:

1. Seismic design criteria: Provide bracing and anchoring for equipment, conduit, cable tray, bust duct, designed, constructed, and installed to resist stresses produced by lateral forces.

D. Design and install seismic anchorage and bracing for all floor or roof mounted equipment weighing 400 pounds or more and all suspended or wall mounted equipment weighing 20 pounds or more.

E. Seismic forces shall be presumed to act through the center of mass of the equipment in a direction that will produce the largest single anchor force.

1.04 SUBMITTALS

A. Shop Drawings:

1. Product technical data:
   a. Seismic control devices.
2. Fabrication and/or layout drawings:
   a. Layout and mounting detail drawings showing system and proposed brace locations for all systems including pre-engineered systems.
   b. The specific detail for each type of brace or anchor must be referenced on a plan that identifies the required location.
      1) Supplying a book of details without referencing the proper detail to a specific location on a plan is not acceptable.
   c. Structural calculations for required lateral force level for each component.
   d. All submittals, including pre-approved systems, shall be signed and sealed by a licensed engineer, licensed in the state in which the project is located.

1.05 PROJECT CONDITIONS

A. Seismic Design Load Criteria:

1. Risk Category: III
2. Site Class: D
3. Design spectral acceleration at short period: SDS = 0.760
4. Design spectral acceleration at 1-second period: SD1 = 0.420
5. Seismic Design Category: D
6. Component or system amplification factor, (ap) and component modification factor (Rp):
7. In accordance with ASCE 7-16, Tables 13.5-1 and 13.6-1
8. Component Importance Factor:
9. All Components: Ip = 1.00

10. Seismic forces must be resisted by direct load transfer through fasteners to seismic-resisting elements. Do not use connections that employ friction to transfer seismic forces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Pre-engineered suspended bracing systems:
   a. International Seismic Application Technology (ISAT) "Engineered Seismic Bracing of Suspended Utilities".
   b. Unistrut by Atkore International, Inc.
   c. TOLCO by Eaton.
   d. B-Line by Eaton.
2. Custom engineered systems designed using specified criteria and common building materials.

2.02 EQUIPMENT ANCHORS AND SUPPORTS

A. Drilled-in-place concrete anchors shall have an approved ICBO Evaluation Services Report.

B. Cast-in-place anchors shall comply with ASTM A36, ASTM A307, or ASTM F1554, 36 ksi.

C. Anchors permanently exposed to weather or corrosive environments shall be stainless steel or hot-dipped galvanized.

D. Structural steel for supports: ASTM A36, A588, A992 or A500.

E. Cold formed metal and connection material: Unistrut, or equal.

F. Any details provided are based on assumed equipment and arrangement.

1. The Contractor shall be responsible for design and acquiring approval for support and anchorage of equipment and arrangement which varies from equipment and arrangement assumed in detail provided.

PART 3 EXECUTION

3.01 GENERAL

A. Every run which requires bracing shall have a minimum of two transverse braces and one longitudinal brace.

1. A "run" is defined as suspended pipe, conduit, cable tray, bus ductor trapeze rack having a minimum 10 feet straight run length.

B. Brace spacing shall not exceed the maximum allowable brace spacing as engineered by the manufacturer or custom bracing designer.

C. Bracing may be omitted from conduit, cable tray and bus duct runs less than 10 feet in length.

D. Bracing may be omitted from conduit, cable tray and bus duct runs where rod hung supports of less than 12 inches. (305 mm) in length are required.

1. All unbraced suspended utility systems having 2 inches conduit and larger or systems weighing more then 5 pounds/FT shall be installed with a minimum 6 inches clearance to suspended ceiling vertical hanger wires.
2. The conduit, cable tray, or bus duct shall be installed such that the lateral motion of the members will not cause damaging impact with other systems or structural members or loss of vertical support.

E. A longitudinal brace at a 90 degrees change in direction may act as a transverse brace if it is located within 2 feet of the change in direction.

F. A transverse brace may act as a longitudinal brace if it is located within 2 feet of a change in direction and if the brace arm and anchorage have been sized to meet or exceed the requirements of the longitudinal brace.

G. When bracing equipment or a utility system that is suspended from an overhead deck, brace back to the overhead deck or to the supporting structure supporting the deck.

1. Do not brace to another element of the structure which may respond differently during a seismic event.

H. Obtain approval from the Structural Engineer prior to attaching any brace elements to structural steel or wood framing.

I. When utilizing cable bracing, tension the cable to remove slack without inducing uplift of the suspended element.

1. Tension seismic bracing system prior to system start-up and adjust if necessary after equipment start-up.

J. As a general rule, do not mix rigid bracing with cable bracing in the same run.

1. However, once bracing has transitioned a 90 degrees change in run direction, the bracing may switch from rigid to cable or vice versa if

required due to a significant change in overhead deck elevation or to provide an implementable bracing scheme in a congested area.

K. Install brace members at an angle of 45 degrees from horizontal within a tolerance of +2-1/2 DEG or -45 degrees provided the brace length is accounted for in design.

1. Brace angle may be increased to 60 degrees provided the brace spacing is reduced to 1/2 that required for a 45 degrees brace.

L. Seismic bracing may not pass through a building separation joint.

1. Utility systems that pass through a separation joint must be seismically restrained no greater than 5 feet from the point of connection.
2. Any hardware designed to accommodate seismic movement across the span of the separation joint shall be installed per manufacturer's installation and listing instructions.

M. With approval of the Structural Engineer, utility systems that are suspended from the overhead deck may be braced to load bearing concrete or CMU (concrete masonry) walls provided that the walls and the overhead decks will respond similarly during a seismic event.

N. Each layer of a multiple layer trapeze rack shall be braced individually based on the weight of the individual layer.

O. Conduit, cable tray, or bus duct constructed of non ductile material (plastic or fiberglass), shall have brace spacing reduced to 1/2 of the spacing allowed for ductile materials.

P. Where brace elements are through-bolted, the mounting hole in the element is to be no more than 1/16 inches in diameter larger then the bolt or threaded rod.

Q. Seismic braces shall directly brace the support and not the hanger.

3.02 SUSPENDED ELECTRICAL SYSTEMS

A. Install seismic bracing for all conduit 2-1/2 inches trade size or greater.

B. All trapeze assemblies supporting conduits, cable trays or bus ducts shall be braced considering the total weight of the elements on the trapeze.

1. For the purposes of calculating weight, all conduits are to be treated as full.

C. Brace all trapeze racks which support conduit 2-1/2 inches trade size or larger.

1. Brace all other conduit rack, cable tray or bus duct trapezes having a minimum weight in excess of 10 pounds/LF.
2. Include a minimum 10% additional capacity for future additions.

D. Seismic bracing may be omitted from cable trays, conduit and bus ducts suspended by rod hung supports 12 inches or less in length from the top of the element to the bottom of the structural attachment of the hanger provided lateral motion will not cause damaging impacts to other systems or loss of system vertical support.

E. For steel and aluminum bus ducts, conduit and cable trays:

1. Provide transverse bracing at 40 feet maximum spacing unless otherwise noted.
2. Provide longitudinal bracing at 80 feet maximum spacing unless otherwise noted.

F. All vertical risers involving conduit 2-1/2 inches in diameter or larger shall include lateral restraint at maximum 30 feet intervals and at the top and bottom of the riser.

G. Make provisions to eliminate seismic impact between components.

3.03 FLOOR OR ROOF MOUNTED EQUIPMENT

A. Provide one anchor on each leg or corner.

1. Support with a minimum of three 3/8 inches diameter anchors.

B. Friction shall be neglected when designing anchors for shear.

C. Vertical seismic forces, when required, shall be presumed to act concurrently with horizontal seismic forces.

D. Electrical cabinet design shall comply with the applicable NEMA standards. Cutouts in the lower shear panel that have not been made by the manufacturer and reduce significantly the strength of the cabinet shall be specifically evaluated.

END OF SECTION

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D877, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
   b. D923, Standard Practice for Sampling Electrical Insulating Liquids.
   c. D924, Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.
   d. D971, Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.
   e. D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration.
   f. D1298, Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
   g. D1500, Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).
   h. D1524, Standard Test Method for Visual Examination of Used Electrical Insulating Oils of Petroleum Origin in the Field.
   i. D1533, Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration.
   j. D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes.
2. Institute of Electrical and Electronics Engineers (IEEE):
   a. 43, Recommended Practice for Testing Insulating Resistance of Rotating Machinery.
   b. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminators Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5kV through 500kV.
   c. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
   d. 95, Recommended Practice for Insulation Testing of AC Electric Machinery (2300V and Above) with High Direct Voltage.
   e. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.

f. 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems.
g. 450, Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.
h. C2, National Electrical Safety Code.
i. C37.20.1, Standard for Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear.
j. C37.20.2, Standard for Metal-Clad Switchgear.
k. C37.20.3, Standard for Metal-Enclosed Interrupter Switchgear.
l. C37.23, Standard for Metal-Enclosed Bus.
m. C62.33, Standard Test Specifications for Varistor Surge-Protective Devices.

3. Insulated Cable Engineers Association (ICEA):
   a. S-93-639, 5-46 kV Shielded Power Cables for Use in the Transmission and Distribution of Electric Energy.
   b. S-94-649, Concentric Neutral Cables Rated 5 through 46 kV.
   c. S-97-682, Standard for Utility Shielded Power Cables Rated 5 through 46 kV.
4. National Electrical Manufacturers Association (NEMA):
   a. AB 4, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
   b. PB 2, Deadfront Distribution Switchboards.
   c. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
5. InterNational Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
6. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 70B, Recommended Practice for Electrical Equipment Maintenance.
   c. 70E, Standard for Electrical Safety in the Workplace.
   d. 101, Life Safety Code.
7. National Institute for Certification in Engineering Technologies (NICET).
8. Occupational Safety and Health Administration (OSHA): CFR 29, Part 1910, Occupational Safety and Health Standards.

1.02 SUBMITTALS

A. Informational Submittals:

1. Submit 30 days prior to performing inspections or tests:
   a. Schedule for performing inspection and tests.
   b. List of references to be used for each test.
   c. Sample copy of equipment and materials inspection form(s).
   d. Sample copy of individual device test form.
   e. Sample copy of individual system test form.
2. Energization Plan: Prior to initial energization of electrical distribution equipment; include the following:
   a. Owner's representative sign-off form for complete and accurate arc flash labeling and proper protective device settings for equipment to be energized.
   b. Staged sequence of initial energization of electrical equipment.
   c. Lock-Out-Tag-Out plan for each stage of the progressive energization.
   d. Barricading, signage, and communication plan notifying personnel of newly energized equipment.
3. Submit test or inspection reports and certificates for each electrical item tested within 30 days after completion of test:
4. Operation and Maintenance Data:
   a. In accordance with the Greenbook, the Whitebook, and Section 01 33 04 – Operation and Maintenance Manuals.
   b. After test or inspection reports and certificates have been reviewed by Engineer and returned, insert a copy of each in Operation and Maintenance Manual.
5. Programmable Settings: At completion of Performance Demonstration Test, submit final hardcopy printout and electronic files on compact disc of as-left setpoints, programs, and device configuration files for:
   a. Protective relays.
   b. Electrical communications modules.

1.03 QUALITY ASSURANCE

A. Testing Firm Qualifications:

1. Corporately and financially independent organization functioning as an unbiased testing authority.
2. Professionally independent of manufacturers, suppliers, and installers of electrical equipment and systems being tested.
3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
4. Supervising engineer accredited as Certified Electrical Test Technologist by NICET or NETA.
5. Technicians certified by NICET or NETA.

6. Assistants and apprentices assigned to Project at ratio not to exceed two certified to one noncertified assistant or apprentice.
7. Registered Professional Engineer to provide comprehensive Project report outlining services performed, results of such services, recommendations, actions taken, and opinions.
8. In compliance with OSHA CFR 29, Part 1910.7 criteria for accreditation of testing laboratories or a full member company of NETA.

B. Test equipment shall have an operating accuracy equal to or greater than requirements established by NETA ATS.

C. Test instrument calibration shall be in accordance with NETA ATS.

1.04 SEQUENCING AND SCHEDULING

A. Perform inspection and electrical tests after equipment listed herein has been installed.

B. Perform tests with apparatus de-energized whenever feasible.

C. Inspection and electrical tests on energized equipment shall be:

1. Scheduled with Engineer prior to de-energization.
2. Minimized to avoid extended period of interruption to the operating plant equipment.

D. Notify Engineer at least 24 hours prior to performing tests on energized electrical equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Tests and inspections shall establish:

1. Electrical equipment is operational within industry and manufacturer's tolerances and standards.
2. Installation operates properly.
3. Equipment is suitable for energization.
4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, NFPA 101, and IEEE C2.

B. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.

C. Adjust mechanisms and moving parts of equipment for free mechanical movement.

D. Adjust and set electromechanical electronic relays and sensors to correspond to operating conditions, or as recommended by manufacturer.

E. Verify nameplate data for conformance to Contract Documents and approved Submittals.

F. Realign equipment not properly aligned and correct unlevelness.

G. Properly anchor electrical equipment found to be inadequately anchored.

H. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench/screw driver to manufacturer's recommendations, or as otherwise specified in NETA ATS.

I. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.

J. Provide proper lubrication of applicable moving parts.

K. Inform Engineer of working clearances not in accordance with NFPA 70.

L. Investigate and repair or replace:

1. Electrical items that fail tests.
2. Active components not operating in accordance with manufacturer's instructions.
3. Damaged electrical equipment.

M. Electrical Enclosures:

1. Remove foreign material and moisture from enclosure interior.
2. Vacuum and wipe clean enclosure interior.
3. Remove corrosion found on metal surfaces.
4. Repair or replace, as determined by Engineer door and panel sections having dented surfaces.
5. Repair or replace, as determined by Engineer poor fitting doors and panel sections.
6. Repair or replace improperly operating latching, locking, or interlocking devices.
7. Replace missing or damaged hardware.
8. Finish:
    a. Provide matching paint and touch up scratches and mars.
    b. If required because of extensive damage, as determined by Engineer, refinish entire assembly.

N. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents or approved Submittals.

O. Replace transformer insulating oil not in compliance with ASTM D923.

3.02 CHECKOUT AND STARTUP

A. Equipment Line Current Tests:

1. Check line current in each phase for each piece of equipment.
2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.
3. If phase current for a piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

B. Electrical Tests:

1. Current Injection Tests:
   a. For entire current circuit in each section.
   b. Secondary injection for current flow of 1 ampere.
   c. Test current at each device.
2. Control Wiring:
   a. Apply secondary voltage to control power and potential circuits.
   b. Check voltage levels at each point on terminal boards and each device terminal.
3. Operational Test:
   a. Initiate control devices.
   b. Check proper operation of control system in each section.

3.03 PANELBOARDS

A. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
2. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer’s instruction manual.
3. Check panelboard mounting, area clearances, and alignment and fit of components.
4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer’s instructions for proper torque values.
5. Perform visual and mechanical inspection for overcurrent protective devices.

B. Electrical Tests: Include the following items performed in accordance with manufacturer's instruction:

1. Ground continuity test ground bus to system ground.

3.04 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect each individual exposed power cable No. 6 and larger for:
   a. Physical damage.
   b. Proper connections in accordance with single-line diagram.
   c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
   d. Color coding conformance with specification.
   e. Proper circuit identification.

2. Mechanical Connections For:
   a. Proper lug type for conductor material.
   b. Proper lug installation.
   c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
3. Shielded Instrumentation Cables For:
   a. Proper shield grounding.
   b. Proper terminations.
   c. Proper circuit identification.
4. Control Cables For:
   a. Proper termination.
   b. Proper circuit identification.
5. Cables Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests for Conductors No. 6 and Larger:

1. Insulation Resistance Tests:
   a. Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors .
   b. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
   c. Evaluate ohmic values by comparison with conductors of same length and type.
   d. Investigate values less than 50 megohms.
2. Continuity test by ohmmeter method to ensure proper cable connections.

3.05 INSTRUMENT TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Visually check current, potential, and control transformers for:
   a. Cracked insulation.
   b. Broken leads or defective wiring.
   c. Proper connections.
   d. Adequate clearances between primary and secondary circuit wiring.
2. Verify Mechanically:
   a. Grounding and shorting connections have good contact.
   b. Withdrawal mechanism and grounding operation, when applicable, operate properly.
3. Verify proper primary and secondary fuse sizes for potential transformers.

B. Electrical Tests:

1. Current Transformer Tests:
   a. Insulation resistance test of transformer and wiring-to-ground at 1,000 volts dc for 30 seconds.
   b. Polarity test.
2. Potential Transformer Tests:
   a. Insulation resistance test at test voltages in accordance with NETA ATS, Table 100.9, for 1 minute on:
      1) Winding-to-winding.
      2) Winding-to-ground.
   b. Polarity test to verify polarity marks or H1-X1 relationship as applicable.
3. Insulation resistance measurement on instrument transformer shall not be less than that shown in NETA ATS, Table 100.5.

3.06 GROUNDING SYSTEMS

A. Visual and Mechanical Inspection:

1. Equipment and circuit grounds in panelboard and control panel assemblies for proper connection and tightness.
2. Ground bus connections in panelboard and control panel assemblies for proper termination and tightness.
3. Effective transformer core and equipment grounding.
4. Accessible connections to grounding electrodes for proper fit and tightness.
5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

B. Electrical Tests:

1. Fall-of-Potential Test:
   a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.

b. Main ground electrode system resistance to ground to be no greater than 5 ohm(s).

2. Two-Point Direct Method Test:
   a. In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.
   b. Equipment ground resistance shall not exceed main ground system resistance by 0.50 ohm.
3. Neutral Bus Isolation:
   a. Test each neutral bus individually with neutral bonding jumper removed at service entrance or separately derived system.
   b. Evaluate ohmic values by measuring resistance between ground bus and neutral bus.
   c. Investigate values less than 50 megohms.

END OF SECTION

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SECTION 40 61 93
PROCESS CONTROL SYSTEM INPUT-OUTPUT LIST

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Process Instrumentation and Control (PIC) System Input/Output (I/O) List description.

B. Related Specification Sections include but are not necessarily limited to:

1. 40 90 00 - Instrumentation and Control for Process Systems.
2. 40 90 04 - References.
3. 40 90 05 - Definitions.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. The International Society of Automation (ISA):
   a. 5.1, Instrumentation Symbols and Identification.

1.03 SUBMITTALS

A. Shop Drawings:

1. Any proposed deviations from the I/O List format, content and attributes stipulated in this Section shall be submitted for approval. I/O List development shall not proceed until the deviation has been approved.

B. Operation and Maintenance Manuals:

1. See the Greenbook, the Whitebook, Section 01 78 43 – Spare Parts and Extra Materials, and Section 01 33 04 – Operation and Maintenance Manuals for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:

1. I/O Lists:
   a. Post-Commissioning Final I/O Lists.
   b. Submit I/O Lists in PDF and native format Microsoft Excel indexed by Area, Panel, and Point Description.

PART 2 PRODUCTS (NOT USED)

2.01 I/O LIST

A. The I/O List in the Appendix 40 61 93A (Input-Output List) to this Section contains I/O point information derived from the Contract drawings and specifications.

B. The I/O List shall be used as the starting point in the development of the final PLC I/O database.

1. The I/O list does not include internal software points generated by the control system and is used solely within the control system.

PART 3 EXECUTION (NOT USED)

3.01 I/O DATABASE DEVELOPMENT

A. The Systems Integrator shall develop the complete I/O List containing all information needed to facilitate panel building, testing and programming, and the fully document the I/O layout and interconnections.

B. The Systems Integrator shall obtain the Owner's existing tag naming conventions, abbreviations, facility codes, standard state descriptors, and other relevant information prior to creating the I/O List.

C. Maintain a copy of the complete I/O List with modifications during construction in native file format. I/O List shall be accessible to Owner and Engineer upon request.

D. Following successful project Commissioning, submit an "As Installed" final I/O List, with all fields representing the updated information, including all field updated information.

3.02 I/O POINT DATA FIELDS

A. Information in the I/O List data fields may be subject to review and modification by the Owner or Engineer during the Submittal review phase.

1. Incorporate changes as directed by the reviewer through the system and associated documentation, at no additional cost to the Owner, subject to the following limitations:
   a. Requested modifications shall be limited to 20% of the total number of I/O points.
      1) This 20% shall not include changes to the I/O List prior to the Submittal review.
      2) Corrections for errors by the Systems Integrator shall not count toward the 20% modification limit.
   b. Each unique change shall count as one modification.

1) For example, modifying the description, range, and engineering unit for one analog input counts as three separate modifications.

c. Analog input alarm limit adjustments shall not count as modifications.

END OF SECTION

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MBC GAS DETECTION SYSTEM REPLACEMENT
INPUT / OUTPUT LIST

I/O #	PCM	Panel	Instrument	Prefix Number	I/O Tag	Loop Number	Tag Number	I/O Type	N/O or N/C	Input/Output Point Description	Area	Location	Bit
1	19PCM02	19PCM02	19-AE/AIT-2100A	19	AAH	2100A	19AAH2100A	DI	N/C	Gas Sensor 1 Methane High Level	Electric Yard	Main Plant Switchgear Building	ALARM
2	19PCM02	19PCM02	19-AE/AIT-2100A	19	AAHH	2100A	19AAHH2100A	DI	N/C	Gas Sensor 1 Methane High-High Level	Electric Yard	Main Plant Switchgear Building	ALARM
3	19PCM02	19PCM02	19-AE/AIT-2100A	19	XA	2100A	19XA2100A	DI	N/C	Gas Sensor 1 Fail	Electric Yard	Main Plant Switchgear Building	ALARM
4	19PCM02	19PCM02	19-AE/AIT-2100B	19	AAH	2100B	19AAH2100B	DI	N/C	Gas Sensor 2 Methane High Level	Electric Yard	Main Plant Switchgear Building	ALARM
5	19PCM02	19PCM02	19-AE/AIT-2100B	19	AAHH	2100B	19AAHH2100B	DI	N/C	Gas Sensor 2 Methane High-High Level	Electric Yard	Main Plant Switchgear Building	ALARM
6	19PCM02	19PCM02	19-AE/AIT-2100B	19	XA	2100B	19XA2100B	DI	N/C	Gas Sensor 2 Fail	Electric Yard	Main Plant Switchgear Building	ALARM
7	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110A	51	AAH	2110A	51AAH2110A	DI	N/C	Gas Sensor 1 Methane High Level	Operations Bldg	South Perimeter	ALARM
8	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110A	51	AAHH	2110A	51AAHH2110A	DI	N/C	Gas Sensor 1 Methane High-High Level	Operations Bldg	South Perimeter	ALARM
9	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110A	51	XA	2110A	51XA2110A	DI	N/C	Gas Sensor 1 Fail	Operations Bldg	South Perimeter	ALARM
10	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110B	51	AAH	2110B	51AAH2110B	DI	N/C	Gas Sensor 2 Methane High Level	Operations Bldg	South Perimeter	ALARM
11	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110B	51	AAHH	2110B	51AAHH2110B	DI	N/C	Gas Sensor 2 Methane High-High Level	Operations Bldg	South Perimeter	ALARM
12	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110B	51	XA	2110B	51XA2110B	DI	N/C	Gas Sensor 2 Fail	Operations Bldg	South Perimeter	ALARM
13	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110C	51	AAH	2110C	51AAH2110C	DI	N/C	Gas Sensor 3 Methane High Level	Operations Bldg	East Perimeter	ALARM
14	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110C	51	AAHH	2110C	51AAHH2110C	DI	N/C	Gas Sensor 3 Methane High-High Level	Operations Bldg	East Perimeter	ALARM
15	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110C	51	XA	2110C	51XA2110C	DI	N/C	Gas Sensor 3 Fail	Operations Bldg	East Perimeter	ALARM
16	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110D	51	AAH	2110D	51AAH2110D	DI	N/C	Gas Sensor 4 Methane High Level	Operations Bldg	East Perimeter	ALARM
17	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110D	51	AAHH	2110D	51AAHH2110D	DI	N/C	Gas Sensor 4 Methane High-High Level	Operations Bldg	East Perimeter	ALARM
18	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110D	51	XA	2110D	51XA2110D	DI	N/C	Gas Sensor 4 Fail	Operations Bldg	East Perimeter	ALARM
19	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110E	51	AAH	2110E	51AAH2110E	DI	N/C	Gas Sensor 5 Methane High Level	Operations Bldg	Roof	ALARM
20	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110E	51	AAHH	2110E	51AAHH2110E	DI	N/C	Gas Sensor 5 Methane High-High Level	Operations Bldg	Roof	ALARM
21	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110E	51	XA	2110E	51XA2110E	DI	N/C	Gas Sensor 5 Fail	Operations Bldg	Roof	ALARM
22	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110F	51	AAH	2110F	51AAH2110F	DI	N/C	Gas Sensor 6 Methane High Level	Operations Bldg	Roof	ALARM
23	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110F	51	AAHH	2110F	51AAHH2110F	DI	N/C	Gas Sensor 6 Methane High-High Level	Operations Bldg	Roof	ALARM
24	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110F	51	XA	2110F	51XA2110F	DI	N/C	Gas Sensor 6 Fail	Operations Bldg	Roof	ALARM
25	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110G	51	AAH	2110G	51AAH2110G	DI	N/C	Gas Sensor 7 Methane High Level	Operations Bldg	Roof	ALARM
26	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110G	51	AAHH	2110G	51AAHH2110G	DI	N/C	Gas Sensor 7 Methane High-High Level	Operations Bldg	Roof	ALARM
27	51PCM01	51-AC-2100.LCP	51-AE/AIT-2110G	51	XA	2110G	51XA2110G	DI	N/C	Gas Sensor 7 Fail	Operations Bldg	Roof	ALARM
28	60PCM01	60-AC-2500.LCP	60-AE/AIT-2500A	60	AAH	2500A	60AAH2500A	DI	N/C	Gas Sensor 1 Methane High Level	Chemical Bldg	Pump Room	ALARM
29	60PCM01	60-AC-2500.LCP	60-AE/AIT-2500A	60	AAHH	2500A	60AAHH2500A	DI	N/C	Gas Sensor 1 Methane High-High Level	Chemical Bldg	Pump Room	ALARM
30	60PCM01	60-AC-2500.LCP	60-AE/AIT-2500A	60	XA	2500A	60XA2500A	DI	N/C	Gas Sensor 1 Fail	Chemical Bldg	Pump Room	ALARM
31	60PCM01	60-AC-2500.LCP	60-FSL-2500A	60	FSL	2500A	60FSL2500A	DI	N/C	Gas Sensor 1 Low Air Flow	Chemical Bldg	Pump Room	ALARM
32	60PCM01	60-AC-2500.LCP	60-AE/AIT-2500B	60	AAH	2500B	60AAH2500B	DI	N/C	Gas Sensor 2 Methane High Level	Chemical Bldg	Aging and Storage Tanks Area	ALARM
33	60PCM01	60-AC-2500.LCP	60-AE/AIT-2500B	60	AAHH	2500B	60AAHH2500B	DI	N/C	Gas Sensor 2 Methane High-High Level	Chemical Bldg	Aging and Storage Tanks Area	ALARM
34	60PCM01	60-AC-2500.LCP	60-AE/AIT-2500B	60	XA	2500B	60XA2500B	DI	N/C	Gas Sensor 2 Fail	Chemical Bldg	Aging and Storage Tanks Area	ALARM
35	60PCM01	60-AC-2500.LCP	60-FSL-2500B	60	FSL	2500B	60FSL2500B	DI	N/C	Gas Sensor 2 Low Air Flow	Chemical Bldg	Aging and Storage Tanks Area	ALARM
36	70PCM01	70-AC-2100.LCP	70-AE/AIT-2100A	70	AAH	2100A	70AAH2100A	DI	N/C	Gas Sensor 1 Methane High Level	Energy Bldg	Boiler Room	ALARM
37	70PCM01	70-AC-2100.LCP	70-AE/AIT-2100A	70	AAHH	2100A	70AAHH2100A	DI	N/C	Gas Sensor 1 Methane High-High Level	Energy Bldg	Boiler Room	ALARM
38	70PCM01	70-AC-2100.LCP	70-AE/AIT-2100A	70	XA	2100A	70XA2100A	DI	N/C	Gas Sensor 1 Fail	Energy Bldg	Boiler Room	ALARM
39	70PCM01	70-AC-2100.LCP	70-AE/AIT-2100B	70	AAH	2100B	70AAH2100B	DI	N/C	Gas Sensor 2 Methane High Level	Energy Bldg	Boiler Room	ALARM
40	70PCM01	70-AC-2100.LCP	70-AE/AIT-2100B	70	AAHH	2100B	70AAHH2100B	DI	N/C	Gas Sensor 2 Methane High-High Level	Energy Bldg	Boiler Room	ALARM

AI: Analog In DI: Digital In DT: Data H/W-Hard-wired
AO:Analog Out DO: Digital Out DTS: Data I/O Mech: mechanical

MBC GAS DETECTION SYSTEM REPLACEMENT
INPUT / OUTPUT LIST

I/O #	PCM	Panel	Instrument	Prefix Number	I/O Tag	Loop Number	Tag Number	I/O Type	N/O or N/C	Input/Output Point Description	Area	Location	Bit
41	70PCM01	70-AC-2100.LCP	70-AE/AIT-2100B	70	XA	2100B	70XA2100B	DI	N/C	Gas Sensor 2 Fail	Energy Bldg	Boiler Room	ALARM
42	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350A	76	AAH	2350A	76AAH2350A	DI	N/C	Gas Sensor 1 Methane High Level	Centrifuge Bldg	Grit Loading Area - First Floor	ALARM
43	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350A	76	AAHH	2350A	76AAHH2350A	DI	N/C	Gas Sensor 1 Methane High-High Level	Centrifuge Bldg	Grit Loading Area - First Floor	ALARM
44	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350A	76	XA	2350A	76XA2350A	DI	N/C	Gas Sensor 1 Fail	Centrifuge Bldg	Grit Loading Area - First Floor	ALARM
45	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350B	76	AAH	2350B	76AAH2350B	DI	N/C	Gas Sensor 2 Ammonia High Level	Centrifuge Bldg	Grit Loading Area - First Floor	ALARM
46	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350B	76	AAHH	2350B	76AAHH2350B	DI	N/C	Gas Sensor 2 Ammonia High-High Level	Centrifuge Bldg	Grit Loading Area - First Floor	ALARM
47	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350B	76	XA	2350B	76XA2350B	DI	N/C	Gas Sensor 2 Fail	Centrifuge Bldg	Grit Loading Area - First Floor	ALARM
48	76PCM06	76-AC-2350.LCP	76-FSL-2350A	76	FSL	2350A	76FSL2350A	DI	N/C	Gas Sensor 1 & 2 Low Air Flow	Centrifuge Bldg	Grit Loading Area - First Floor	ALARM
49	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350C	76	AAH	2350C	76AAH2350C	DI	N/C	Gas Sensor 3 Carbon Monoxide High Level	Centrifuge Bldg	Grit Loading Area - First Floor	ALARM
50	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350C	76	AAHH	2350C	76AAHH2350C	DI	N/C	Gas Sensor 3 Carbon Monoxide High-High Level	Centrifuge Bldg	Grit Loading Area - First Floor	ALARM
51	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350C	76	XA	2350C	76XA2350C	DI	N/C	Gas Sensor 3 Fail	Centrifuge Bldg	Grit Loading Area - First Floor	ALARM
52	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350D	76	AAH	2350D	76AAH2350D	DI	N/C	Gas Sensor 4 Methane High Level	Centrifuge Bldg	Grit Loading Area - Second Floor	ALARM
53	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350D	76	AAHH	2350D	76AAHH2350D	DI	N/C	Gas Sensor 4 Methane High-High Level	Centrifuge Bldg	Grit Loading Area - Second Floor	ALARM
54	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350D	76	XA	2350D	76XA2350D	DI	N/C	Gas Sensor 4 Fail	Centrifuge Bldg	Grit Loading Area - Second Floor	ALARM
55	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350E	76	AAH	2350E	76AAH2350E	DI	N/C	Gas Sensor 5 Ammonia High Level	Centrifuge Bldg	Grit Loading Area - Second Floor	ALARM
56	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350E	76	AAHH	2350E	76AAHH2350E	DI	N/C	Gas Sensor 5 Ammonia High-High Level	Centrifuge Bldg	Grit Loading Area - Second Floor	ALARM
57	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350E	76	XA	2350E	76XA2350E	DI	N/C	Gas Sensor 5 Fail	Centrifuge Bldg	Grit Loading Area - Second Floor	ALARM
58	76PCM06	76-AC-2350.LCP	76-FSL-2350D	76	FSL	2350D	76FSL2350D	DI	N/C	Gas Sensor 4 & 5 Low Air Flow	Centrifuge Bldg	Grit Loading Area - Second Floor	ALARM
59	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350F	76	AAH	2350F	76AAH2350F	DI	N/C	Gas Sensor 6 Carbon Monoxide High Level	Centrifuge Bldg	Grit Loading Area - Second Floor	ALARM
60	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350F	76	AAHH	2350F	76AAHH2350F	DI	N/C	Gas Sensor 6 Carbon Monoxide High-High Level	Centrifuge Bldg	Grit Loading Area - Second Floor	ALARM
61	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350F	76	XA	2350F	76XA2350F	DI	N/C	Gas Sensor 6 Fail	Centrifuge Bldg	Grit Loading Area - Second Floor	ALARM
62	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350G	76	AAH	2350G	76AAH2350G	DI	N/C	Gas Sensor 7 Methane High Level	Centrifuge Bldg	Chemical Area	ALARM
63	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350G	76	AAHH	2350G	76AAHH2350G	DI	N/C	Gas Sensor 7 Methane High-High Level	Centrifuge Bldg	Chemical Area	ALARM
64	76PCM06	76-AC-2350.LCP	76-AE/AIT-2350G	76	XA	2350G	76XA2350G	DI	N/C	Gas Sensor 7 Fail	Centrifuge Bldg	Chemical Area	ALARM
65	76PCM06	76-AC-2350.LCP	76-FSL-2350G	76	FSL	2350G	76FSL2350G	DI	N/C	Gas Sensor 7 Low Air Flow	Centrifuge Bldg	Chemical Area	ALARM
66	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355A	76	AAH	2355A	76AAH2355A	DI	N/C	Gas Sensor 1 Methane High Level	Centrifuge Bldg	First Floor	ALARM
67	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355A	76	AAHH	2355A	76AAHH2355A	DI	N/C	Gas Sensor 1 Methane High-High Level	Centrifuge Bldg	First Floor	ALARM
68	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355A	76	XA	2355A	76XA2355A	DI	N/C	Gas Sensor 1 Fail	Centrifuge Bldg	First Floor	ALARM
69	76PCM08	76-AC-2355.LCP	76-FSL-2355A	76	FSL	2355A	76FSL2355A	DI	N/C	Gas Sensor 1 Low Air Flow	Centrifuge Bldg	First Floor	ALARM
70	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355B	76	AAH	2355B	76AAH2355B	DI	N/C	Gas Sensor 2 Methane High Level	Centrifuge Bldg	First Floor	ALARM

AI: Analog In DI: Digital In DT: Data H/W-Hard-wired
AO:Analog Out DO: Digital Out DTS: Data I/O Mech: mechanical

MBC GAS DETECTION SYSTEM REPLACEMENT
INPUT / OUTPUT LIST

I/O #	PCM	Panel	Instrument	Prefix Number	I/O Tag	Loop Number	Tag Number	I/O Type	N/O or N/C	Input/Output Point Description	Area	Location	Bit
71	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355B	76	AAHH	2355B	76AAHH2355B	DI	N/C	Gas Sensor 2 Methane High-High Level	Centrifuge Bldg	First Floor	ALARM
72	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355B	76	XA	2355B	76XA2355B	DI	N/C	Gas Sensor 2 Fail	Centrifuge Bldg	First Floor	ALARM
73	76PCM08	76-AC-2355.LCP	76-FSL-2355B	76	FSL	2355B	76FSL2355B	DI	N/C	Gas Sensor 2 Low Air Flow	Centrifuge Bldg	First Floor	ALARM
74	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355C	76	AAH	2355C	76AAH2355C	DI	N/C	Gas Sensor 3 Methane High Level	Centrifuge Bldg	First Floor	ALARM
75	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355C	76	AAHH	2355C	76AAHH2355C	DI	N/C	Gas Sensor 3 Methane High-High Level	Centrifuge Bldg	First Floor	ALARM
76	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355C	76	XA	2355C	76XA2355C	DI	N/C	Gas Sensor 3 Fail	Centrifuge Bldg	First Floor	ALARM
77	76PCM08	76-AC-2355.LCP	76-FSL-2355C	76	FSL	2355C	76FSL2355C	DI	N/C	Gas Sensor 3 Low Air Flow	Centrifuge Bldg	First Floor	ALARM
78	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355D	76	AAH	2355D	76AAH2355D	DI	N/C	Gas Sensor 4 Methane High Level	Centrifuge Bldg	First Floor	ALARM
79	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355D	76	AAHH	2355D	76AAHH2355D	DI	N/C	Gas Sensor 4 Methane High-High Level	Centrifuge Bldg	First Floor	ALARM
80	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355D	76	XA	2355D	76XA2355D	DI	N/C	Gas Sensor 4 Fail	Centrifuge Bldg	First Floor	ALARM
81	76PCM08	76-AC-2355.LCP	76-FSL-2355D	76	FSL	2355D	76FSL2355D	DI	N/C	Gas Sensor 4 Low Air Flow	Centrifuge Bldg	First Floor	ALARM
82	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355E	76	AAH	2355E	76AAH2355E	DI	N/C	Gas Sensor 5 Methane High Level	Centrifuge Bldg	First Floor	ALARM
83	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355E	76	AAHH	2355E	76AAHH2355E	DI	N/C	Gas Sensor 5 Methane High-High Level	Centrifuge Bldg	First Floor	ALARM
84	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355E	76	XA	2355E	76XA2355E	DI	N/C	Gas Sensor 5 Fail	Centrifuge Bldg	First Floor	ALARM
85	76PCM08	76-AC-2355.LCP	76-FSL-2355E	76	FSL	2355E	76FSL2355E	DI	N/C	Gas Sensor 5 Low Air Flow	Centrifuge Bldg	First Floor	ALARM
86	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355F	76	AAH	2355F	76AAH2355F	DI	N/C	Gas Sensor 6 Methane High Level	Centrifuge Bldg	First Floor	ALARM
87	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355F	76	AAHH	2355F	76AAHH2355F	DI	N/C	Gas Sensor 6 Methane High-High Level	Centrifuge Bldg	First Floor	ALARM
88	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355F	76	XA	2355F	76XA2355F	DI	N/C	Gas Sensor 6 Fail	Centrifuge Bldg	First Floor	ALARM
89	76PCM08	76-AC-2355.LCP	76-FSL-2355F	76	FSL	2355F	76FSL2355F	DI	N/C	Gas Sensor 6 Low Air Flow	Centrifuge Bldg	First Floor	ALARM
90	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355G	76	AAH	2355G	76AAH2355G	DI	N/C	Gas Sensor 7 Methane High Level	Centrifuge Bldg	First Floor	ALARM
91	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355G	76	AAHH	2355G	76AAHH2355G	DI	N/C	Gas Sensor 7 Methane High-High Level	Centrifuge Bldg	First Floor	ALARM
92	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355G	76	XA	2355G	76XA2355G	DI	N/C	Gas Sensor 7 Fail	Centrifuge Bldg	First Floor	ALARM
93	76PCM08	76-AC-2355.LCP	76-FSL-2355G	76	FSL	2355G	76FSL2355G	DI	N/C	Gas Sensor 7 Low Air Flow	Centrifuge Bldg	First Floor	ALARM
94	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355H	76	AAH	2355H	76AAH2355H	DI	N/C	Gas Sensor 8 Methane High Level	Centrifuge Bldg	Second Floor - Lab	ALARM
95	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355H	76	AAHH	2355H	76AAHH2355H	DI	N/C	Gas Sensor 8 Methane High-High Level	Centrifuge Bldg	Second Floor - Lab	ALARM
96	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355H	76	XA	2355H	76XA2355H	DI	N/C	Gas Sensor 8 Fail	Centrifuge Bldg	Second Floor - Lab	ALARM
97	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355J	76	AAH	2355J	76AAH2355J	DI	N/C	Gas Sensor 9 Methane High Level	Centrifuge Bldg	Second Floor - Op Control Room	ALARM
98	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355J	76	AAHH	2355J	76AAHH2355J	DI	N/C	Gas Sensor 9 Methane High-High Level	Centrifuge Bldg	Second Floor - Op Control Room	ALARM
99	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355J	76	XA	2355J	76XA2355J	DI	N/C	Gas Sensor 9 Fail	Centrifuge Bldg	Second Floor - Op Control Room	ALARM
100	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355K	76	AAH	2355K	76AAH2355K	DI	N/C	Gas Sensor 10 Methane High Level	Centrifuge Bldg	Second Floor	ALARM
101	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355K	76	AAHH	2355K	76AAHH2355K	DI	N/C	Gas Sensor 10 Methane High-High Level	Centrifuge Bldg	Second Floor	ALARM
102	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355K	76	XA	2355K	76XA2355K	DI	N/C	Gas Sensor 10 Fail	Centrifuge Bldg	Second Floor	ALARM
103	76PCM08	76-AC-2355.LCP	76-FSL-2355K	76	FSL	2355K	76FSL2355K	DI	N/C	Gas Sensor 10 Low Air Flow	Centrifuge Bldg	Second Floor	ALARM
104	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355L	76	AAH	2355L	76AAH2355L	DI	N/C	Gas Sensor 11 Methane High Level	Centrifuge Bldg	Second Floor	ALARM
105	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355L	76	AAHH	2355L	76AAHH2355L	DI	N/C	Gas Sensor 11 Methane High-High Level	Centrifuge Bldg	Second Floor	ALARM
106	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355L	76	XA	2355L	76XA2355L	DI	N/C	Gas Sensor 11 Fail	Centrifuge Bldg	Second Floor	ALARM
107	76PCM08	76-AC-2355.LCP	76-FSL-2355L	76	FSL	2355L	76FSL2355L	DI	N/C	Gas Sensor 11 Low Air Flow	Centrifuge Bldg	Second Floor	ALARM
108	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355M	76	AAH	2355M	76AAH2355M	DI	N/C	Gas Sensor 12 Methane High Level	Centrifuge Bldg	Second Floor	ALARM
109	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355M	76	AAHH	2355M	76AAHH2355M	DI	N/C	Gas Sensor 12 Methane High-High Level	Centrifuge Bldg	Second Floor	ALARM
110	76PCM08	76-AC-2355.LCP	76-AE/AIT-2355M	76	XA	2355M	76XA2355M	DI	N/C	Gas Sensor 12 Fail	Centrifuge Bldg	Second Floor	ALARM
111	76PCM08	76-AC-2355.LCP	76-FSL-2355M	76	FSL	2355M	76FSL2355M	DI	N/C	Gas Sensor 12 Low Air Flow	Centrifuge Bldg	Second Floor	ALARM
112	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500A	80	AAH	2500A	80AAH2500A	DI	N/C	Gas Sensor 1 Methane High Level	Digester Complex	Tunnels	ALARM
113	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500A	80	AAHH	2500A	80AAHH2500A	DI	N/C	Gas Sensor 1 Methane High-High Level	Digester Complex	Tunnels	ALARM
114	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500A	80	XA	2500A	80XA2500A	DI	N/C	Gas Sensor 1 Fail	Digester Complex	Tunnels	ALARM
115	80PCM06	80-AC-2350.LCP	80-FSL-2500A	80	FSL	2500A	80FSL2500A	DI	N/C	Gas Sensor 1 Low Air Flow	Digester Complex	Tunnels	ALARM
116	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500B	80	AAH	2500B	80AAH2500B	DI	N/C	Gas Sensor 2 Methane High Level	Digester Complex	Tunnels	ALARM
117	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500B	80	AAHH	2500B	80AAHH2500B	DI	N/C	Gas Sensor 2 Methane High-High Level	Digester Complex	Tunnels	ALARM

AI: Analog In DI: Digital In DT: Data H/W-Hard-wired
AO:Analog Out DO: Digital Out DTS: Data I/O Mech: mechanical

MBC GAS DETECTION SYSTEM REPLACEMENT
INPUT / OUTPUT LIST

I/O #	PCM	Panel	Instrument	Prefix Number	I/O Tag	Loop Number	Tag Number	I/O Type	N/O or N/C	Input/Output Point Description	Area	Location	Bit
118	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500B	80	XA	2500B	80XA2500B	DI	N/C	Gas Sensor 2 Fail	Digester Complex	Tunnels	ALARM
119	80PCM06	80-AC-2350.LCP	80-FSL-2500B	80	FSL	2500B	80FSL2500B	DI	N/C	Gas Sensor 2 Low Air Flow	Digester Complex	Tunnels	ALARM
120	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500C	80	AAH	2500C	80AAH2500C	DI	N/C	Gas Sensor 3 Methane High Level	Digester Complex	Tunnels	ALARM
121	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500C	80	AAHH	2500C	80AAHH2500C	DI	N/C	Gas Sensor 3 Methane High-High Level	Digester Complex	Tunnels	ALARM
122	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500C	80	XA	2500C	80XA2500C	DI	N/C	Gas Sensor 3 Fail	Digester Complex	Tunnels	ALARM
123	80PCM06	80-AC-2350.LCP	80-FSL-2500C	80	FSL	2500C	80FSL2500C	DI	N/C	Gas Sensor 3 Low Air Flow	Digester Complex	Tunnels	ALARM
124	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500D	80	AAH	2500D	80AAH2500D	DI	N/C	Gas Sensor 4 Methane High Level	Digester Complex	Tunnels	ALARM
125	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500D	80	AAHH	2500D	80AAHH2500D	DI	N/C	Gas Sensor 4 Methane High-High Level	Digester Complex	Tunnels	ALARM
126	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500D	80	XA	2500D	80XA2500D	DI	N/C	Gas Sensor 4 Fail	Digester Complex	Tunnels	ALARM
127	80PCM06	80-AC-2350.LCP	80-FSL-2500D	80	FSL	2500D	80FSL2500D	DI	N/C	Gas Sensor 4 Low Air Flow	Digester Complex	Tunnels	ALARM
128	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500E	80	AAH	2500E	80AAH2500E	DI	N/C	Gas Sensor 5 Methane High Level	Digester Complex	Tunnels	ALARM
129	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500E	80	AAHH	2500E	80AAHH2500E	DI	N/C	Gas Sensor 5 Methane High-High Level	Digester Complex	Tunnels	ALARM
130	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500E	80	XA	2500E	80XA2500E	DI	N/C	Gas Sensor 5 Fail	Digester Complex	Tunnels	ALARM
131	80PCM06	80-AC-2350.LCP	80-FSL-2500E	80	FSL	2500E	80FSL2500E	DI	N/C	Gas Sensor 5 Low Air Flow	Digester Complex	Tunnels	ALARM
132	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500F	80	AAH	2500F	80AAH2500F	DI	N/C	Gas Sensor 6 Methane High Level	Digester Complex	Tunnels	ALARM
133	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500F	80	AAHH	2500F	80AAHH2500F	DI	N/C	Gas Sensor 6 Methane High-High Level	Digester Complex	Tunnels	ALARM
134	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500F	80	XA	2500F	80XA2500F	DI	N/C	Gas Sensor 6 Fail	Digester Complex	Tunnels	ALARM
135	80PCM06	80-AC-2350.LCP	80-FSL-2500F	80	FSL	2500F	80FSL2500F	DI	N/C	Gas Sensor 6 Low Air Flow	Digester Complex	Tunnels	ALARM
136	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500G	80	AAH	2500G	80AAH2500G	DI	N/C	Gas Sensor 7 Methane High Level	Digester Complex	Tunnels	ALARM
137	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500G	80	AAHH	2500G	80AAHH2500G	DI	N/C	Gas Sensor 7 Methane High-High Level	Digester Complex	Tunnels	ALARM
138	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500G	80	XA	2500G	80XA2500G	DI	N/C	Gas Sensor 7 Fail	Digester Complex	Tunnels	ALARM
139	80PCM06	80-AC-2350.LCP	80-FSL-2500G	80	FSL	2500G	80FSL2500G	DI	N/C	Gas Sensor 7 Low Air Flow	Digester Complex	Tunnels	ALARM
140	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500H	80	AAH	2500H	80AAH2500H	DI	N/C	Gas Sensor 8 Methane High Level	Digester Complex	Tunnels	ALARM
141	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500H	80	AAHH	2500H	80AAHH2500H	DI	N/C	Gas Sensor 8 Methane High-High Level	Digester Complex	Tunnels	ALARM
142	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500H	80	XA	2500H	80XA2500H	DI	N/C	Gas Sensor 8 Fail	Digester Complex	Tunnels	ALARM
143	80PCM06	80-AC-2350.LCP	80-FSL-2500H	80	FSL	2500H	80FSL2500H	DI	N/C	Gas Sensor 8 Low Air Flow	Digester Complex	Tunnels	ALARM
144	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500J	80	AAH	2500J	80AAH2500J	DI	N/C	Gas Sensor 9 Methane High Level	Digester Complex	Tunnels	ALARM
145	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500J	80	AAHH	2500J	80AAHH2500J	DI	N/C	Gas Sensor 9 Methane High-High Level	Digester Complex	Tunnels	ALARM
146	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500J	80	XA	2500J	80XA2500J	DI	N/C	Gas Sensor 9 Fail	Digester Complex	Tunnels	ALARM
147	80PCM06	80-AC-2350.LCP	80-FSL-2500J	80	FSL	2500J	80FSL2500J	DI	N/C	Gas Sensor 9 Low Air Flow	Digester Complex	Tunnels	ALARM
148	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500K	80	AAH	2500K	80AAH2500K	DI	N/C	Gas Sensor 10 Methane High Level	Digester Complex	Electrical Room	ALARM
149	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500K	80	AAHH	2500K	80AAHH2500K	DI	N/C	Gas Sensor 10 Methane High-High Level	Digester Complex	Electrical Room	ALARM
150	80PCM06	80-AC-2350.LCP	80-AE/AIT-2500K	80	XA	2500K	80XA2500K	DI	N/C	Gas Sensor 10 Fail	Digester Complex	Electrical Room	ALARM
151	86PCM02	86-AC-2350.LCP	86-AE/AIT-2350A	86	AAH	2350A	86AAH2350A	DI	N/C	Gas Sensor 1 H2S High Level	Dewatered Biosolids Storage Bldg	First Floor	ALARM
152	86PCM02	86-AC-2350.LCP	86-AE/AIT-2350A	86	AAHH	2350A	86AAHH2350A	DI	N/C	Gas Sensor 1 H2S High-High Level	Dewatered Biosolids Storage Bldg	First Floor	ALARM
153	86PCM02	86-AC-2350.LCP	86-AE/AIT-2350A	86	XA	2350A	86XA2350A	DI	N/C	Gas Sensor 1 Fail	Dewatered Biosolids Storage Bldg	First Floor	ALARM
154	86PCM02	86-AC-2350.LCP	86-AE/AIT-2350B	86	AAH	2350B	86AAH2350B	DI	N/C	Gas Sensor 2 CO High Level	Dewatered Biosolids Storage Bldg	First Floor	ALARM
155	86PCM02	86-AC-2350.LCP	86-AE/AIT-2350B	86	AAHH	2350B	86AAHH2350B	DI	N/C	Gas Sensor 2 CO High-High Level	Dewatered Biosolids Storage Bldg	First Floor	ALARM
156	86PCM02	86-AC-2350.LCP	86-AE/AIT-2350B	86	XA	2350B	86XA2350B	DI	N/C	Gas Sensor 2 Fail	Dewatered Biosolids Storage Bldg	First Floor	ALARM
157	86PCM02	86-AC-2350.LCP	86-AE/AIT-2350C	86	AAH	2350C	86AAH2350C	DI	N/C	Gas Sensor 3 H2S High Level	Dewatered Biosolids Storage Bldg	First Floor	ALARM
158	86PCM02	86-AC-2350.LCP	86-AE/AIT-2350C	86	AAHH	2350C	86AAHH2350C	DI	N/C	Gas Sensor 3 H2S High-High Level	Dewatered Biosolids Storage Bldg	First Floor	ALARM

AI: Analog In DI: Digital In DT: Data H/W-Hard-wired
AO:Analog Out DO: Digital Out DTS: Data I/O Mech: mechanical

MBC GAS DETECTION SYSTEM REPLACEMENT
INPUT / OUTPUT LIST

I/O #	PCM	Panel	Instrument	Prefix Number	I/O Tag	Loop Number	Tag Number	I/O Type	N/O or N/C	Input/Output Point Description	Area	Location	Bit
159	86PCM02	86-AC-2350.LCP	86-AE/AIT-2350C	86	XA	2350C	86XA2350C	DI	N/C	Gas Sensor 3 Fail	Dewatered Biosolids Storage Bldg	First Floor	ALARM
160	86PCM02	86-AC-2350.LCP	86-AE/AIT-2350D	86	AAH	2350D	86AAH2350D	DI	N/C	Gas Sensor 4 CO High Level	Dewatered Biosolids Storage Bldg	First Floor	ALARM
161	86PCM02	86-AC-2350.LCP	86-AE/AIT-2350D	86	AAHH	2350D	86AAHH2350D	DI	N/C	Gas Sensor 4 CO High-High Level	Dewatered Biosolids Storage Bldg	First Floor	ALARM
162	86PCM02	86-AC-2350.LCP	86-AE/AIT-2350D	86	XA	2350D	86XA2350D	DI	N/C	Gas Sensor 4 Fail	Dewatered Biosolids Storage Bldg	First Floor	ALARM
163	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355A	86	AAH	2355A	86AAH2355A	DI	N/C	Gas Sensor 1 Methane High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
164	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355A	86	AAHH	2355A	86AAHH2355A	DI	N/C	Gas Sensor 1 Methane High-High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
165	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355A	86	XA	2355A	86XA2355A	DI	N/C	Gas Sensor 1 Fail	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
166	86PCM03	86-AC-2355.LCP	86-FSL-2355A	86	FSL	2355A	86FSL2355A	DI	N/C	Gas Sensor 1 Low Air Flow	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
167	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355B	86	AAH	2355B	86AAH2355B	DI	N/C	Gas Sensor 2 Methane High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
168	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355B	86	AAHH	2355B	86AAHH2355B	DI	N/C	Gas Sensor 2 Methane High-High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
169	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355B	86	XA	2355B	86XA2355B	DI	N/C	Gas Sensor 2 Fail	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
170	86PCM03	86-AC-2355.LCP	86-FSL-2355B	86	FSL	2355B	86FSL2355B	DI	N/C	Gas Sensor 2 Low Air Flow	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
171	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355C	86	AAH	2355C	86AAH2355C	DI	N/C	Gas Sensor 3 Methane High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
172	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355C	86	AAHH	2355C	86AAHH2355C	DI	N/C	Gas Sensor 3 Methane High-High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
173	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355C	86	XA	2355C	86XA2355C	DI	N/C	Gas Sensor 3 Fail	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
174	86PCM03	86-AC-2355.LCP	86-FSL-2355C	86	FSL	2355C	86FSL2355C	DI	N/C	Gas Sensor 3 Low Air Flow	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
175	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355D	86	AAH	2355D	86AAH2355D	DI	N/C	Gas Sensor 4 Methane High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
176	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355D	86	AAHH	2355D	86AAHH2355D	DI	N/C	Gas Sensor 4 Methane High-High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
177	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355D	86	XA	2355D	86XA2355D	DI	N/C	Gas Sensor 4 Fail	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
178	86PCM03	86-AC-2355.LCP	86-FSL-2355D	86	FSL	2355D	86FSL2355D	DI	N/C	Gas Sensor 4 Low Air Flow	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
179	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355E	86	AAH	2355E	86AAH2355E	DI	N/C	Gas Sensor 5 Methane High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
180	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355E	86	AAHH	2355E	86AAHH2355E	DI	N/C	Gas Sensor 5 Methane High-High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
181	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355E	86	XA	2355E	86XA2355E	DI	N/C	Gas Sensor 5 Fail	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
182	86PCM03	86-AC-2355.LCP	86-FSL-2355E	86	FSL	2355E	86FSL2355E	DI	N/C	Gas Sensor 5 Low Air Flow	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
183	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355F	86	AAH	2355F	86AAH2355F	DI	N/C	Gas Sensor 6 Methane High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM

AI: Analog In DI: Digital In DT: Data H/W-Hard-wired
AO:Analog Out DO: Digital Out DTS: Data I/O Mech: mechanical

MBC GAS DETECTION SYSTEM REPLACEMENT
INPUT / OUTPUT LIST

I/O #	PCM	Panel	Instrument	Prefix Number	I/O Tag	Loop Number	Tag Number	I/O Type	N/O or N/C	Input/Output Point Description	Area	Location	Bit
184	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355F	86	AAHH	2355F	86AAHH2355F	DI	N/C	Gas Sensor 6 Methane High-High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
185	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355F	86	XA	2355F	86XA2355F	DI	N/C	Gas Sensor 6 Fail	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
186	86PCM03	86-AC-2355.LCP	86-FSL-2355F	86	FSL	2355F	86FSL2355F	DI	N/C	Gas Sensor 6 Low Air Flow	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
187	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355G	86	AAH	2355G	86AAH2355G	DI	N/C	Gas Sensor 7 Methane High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
188	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355G	86	AAHH	2355G	86AAHH2355G	DI	N/C	Gas Sensor 7 Methane High-High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
189	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355G	86	XA	2355G	86XA2355G	DI	N/C	Gas Sensor 7 Fail	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
190	86PCM03	86-AC-2355.LCP	86-FSL-2355G	86	FSL	2355G	86FSL2355G	DI	N/C	Gas Sensor 7 Low Air Flow	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
191	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355H	86	AAH	2355H	86AAH2355H	DI	N/C	Gas Sensor 8 Methane High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
192	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355H	86	AAHH	2355H	86AAHH2355H	DI	N/C	Gas Sensor 8 Methane High-High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
193	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355H	86	XA	2355H	86XA2355H	DI	N/C	Gas Sensor 8 Fail	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
194	86PCM03	86-AC-2355.LCP	86-FSL-2355H	86	FSL	2355H	86FSL2355H	DI	N/C	Gas Sensor 8 Low Air Flow	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
195	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355J	86	AAH	2355J	86AAH2355J	DI	N/C	Gas Sensor 9 Methane High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
196	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355J	86	AAHH	2355J	86AAHH2355J	DI	N/C	Gas Sensor 9 Methane High-High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
197	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355J	86	XA	2355J	86XA2355J	DI	N/C	Gas Sensor 9 Fail	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
198	86PCM03	86-AC-2355.LCP	86-FSL-2355J	86	FSL	2355J	86FSL2355J	DI	N/C	Gas Sensor 9 Low Air Flow	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
199	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355K	86	AAH	2355K	86AAH2355K	DI	N/C	Gas Sensor 10 Methane High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
200	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355K	86	AAHH	2355K	86AAHH2355K	DI	N/C	Gas Sensor 10 Methane High-High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
201	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355K	86	XA	2355K	86XA2355K	DI	N/C	Gas Sensor 10 Fail	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
202	86PCM03	86-AC-2355.LCP	86-FSL-2355K	86	FSL	2355K	86FSL2355K	DI	N/C	Gas Sensor 10 Low Air Flow	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
203	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355L	86	AAH	2355L	86AAH2355L	DI	N/C	Gas Sensor 11 Methane High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
204	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355L	86	AAHH	2355L	86AAHH2355L	DI	N/C	Gas Sensor 11 Methane High-High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
205	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355L	86	XA	2355L	86XA2355L	DI	N/C	Gas Sensor 11 Fail	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
206	86PCM03	86-AC-2355.LCP	86-FSL-2355L	86	FSL	2355L	86FSL2355L	DI	N/C	Gas Sensor 11 Low Air Flow	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
207	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355M	86	AAH	2355M	86AAH2355M	DI	N/C	Gas Sensor 12 Methane High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
208	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355M	86	AAHH	2355M	86AAHH2355M	DI	N/C	Gas Sensor 12 Methane High-High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM

AI: Analog In DI: Digital In DT: Data H/W-Hard-wired
AO:Analog Out DO: Digital Out DTS: Data I/O Mech: mechanical

MBC GAS DETECTION SYSTEM REPLACEMENT
INPUT / OUTPUT LIST

I/O #	PCM	Panel	Instrument	Prefix Number	I/O Tag	Loop Number	Tag Number	I/O Type	N/O or N/C	Input/Output Point Description	Area	Location	Bit
209	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355M	86	XA	2355M	86XA2355M	DI	N/C	Gas Sensor 12 Fail	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
210	86PCM03	86-AC-2355.LCP	86-FSL-2355M	86	FSL	2355M	86FSL2355M	DI	N/C	Gas Sensor 12 Low Air Flow	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
211	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355N	86	AAH	2355M	86AAH2355M	DI	N/C	Gas Sensor 13 Methane High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
212	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355N	86	AAHH	2355N	86AAHH2355N	DI	N/C	Gas Sensor 13 Methane High-High Level	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
213	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355N	86	XA	2355N	86XA2355N	DI	N/C	Gas Sensor 13 Fail	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
214	86PCM03	86-AC-2355.LCP	86-FSL-2355N	86	FSL	2355N	86FSL2355N	DI	N/C	Gas Sensor 13 Low Air Flow	Dewatered Biosolids Storage Bldg	Tunnels	ALARM
215	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355P	86	AAH	2355P	86AAH2355P	DI	N/C	Gas Sensor 14 Methane High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
216	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355P	86	AAHH	2355P	86AAHH2355P	DI	N/C	Gas Sensor 14 Methane High-High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
217	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355P	86	XA	2355P	86XA2355P	DI	N/C	Gas Sensor 14 Fail	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
218	86PCM03	86-AC-2355.LCP	86-FSL-2355P	86	FSL	2355P	86FSL2355P	DI	N/C	Gas Sensor 14 Low Air Flow	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
219	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355Q	86	AAH	2355Q	86AAH2355Q	DI	N/C	Gas Sensor 15 Ammonia High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
220	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355Q	86	AAHH	2355Q	86AAHH2355Q	DI	N/C	Gas Sensor 15 Ammonia High-High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
221	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355Q	86	XA	2355Q	86XA2355Q	DI	N/C	Gas Sensor 15 Fail	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
222	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355R	86	AAH	2355R	86AAH2355R	DI	N/C	Gas Sensor 16 Methane High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
223	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355R	86	AAHH	2355R	86AAHH2355R	DI	N/C	Gas Sensor 16 Methane High-High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
224	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355R	86	XA	2355R	86XA2355R	DI	N/C	Gas Sensor 16 Fail	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
225	86PCM03	86-AC-2355.LCP	86-FSL-2355Q	86	FSL	2355Q	86FSL2355Q	DI	N/C	Gas Sensors 15 & 16 Low Air Flow	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
226	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355S	86	AAH	2355S	86AAH2355S	DI	N/C	Gas Sensor 17 Ammonia High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
227	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355S	86	AAHH	2355S	86AAHH2355S	DI	N/C	Gas Sensor 17 Ammonia High-High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
228	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355S	86	XA	2355S	86XA2355S	DI	N/C	Gas Sensor 17 Fail	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
229	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355T	86	AAH	2355T	86AAH2355T	DI	N/C	Gas Sensor 18 Methane High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
230	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355T	86	AAHH	2355T	86AAHH2355T	DI	N/C	Gas Sensor 18 Methane High-High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
231	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355T	86	XA	2355T	86XA2355T	DI	N/C	Gas Sensor 18 Fail	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
232	86PCM03	86-AC-2355.LCP	86-FSL-2355S	86	FSL	2355S	86FSL2355S	DI	N/C	Gas Sensors 17 & 18 Low Air Flow	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
233	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355U	86	AAH	2355U	86AAH2355U	DI	N/C	Gas Sensor 19 Methane High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM

AI: Analog In DI: Digital In DT: Data H/W-Hard-wired
AO:Analog Out DO: Digital Out DTS: Data I/O Mech: mechanical

MBC GAS DETECTION SYSTEM REPLACEMENT
INPUT / OUTPUT LIST

I/O #	PCM	Panel	Instrument	Prefix Number	I/O Tag	Loop Number	Tag Number	I/O Type	N/O or N/C	Input/Output Point Description	Area	Location	Bit
234	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355U	86	AAHH	2355U	86AAHH2355U	DI	N/C	Gas Sensor 19 Methane High-High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
235	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355U	86	XA	2355U	86XA2355U	DI	N/C	Gas Sensor 19 Fail	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
236	86PCM03	86-AC-2355.LCP	86-FSL-2355U	86	FSL	2355U	86FSL2355U	DI	N/C	Gas Sensor 19 Low Air Flow	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
237	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355V	86	AAH	2355V	86AAH2355V	DI	N/C	Gas Sensor 20 Methane High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
238	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355V	86	AAHH	2355V	86AAHH2355V	DI	N/C	Gas Sensor 20 Methane High-High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
239	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355V	86	XA	2355V	86XA2355V	DI	N/C	Gas Sensor 20 Fail	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
240	86PCM03	86-AC-2355.LCP	86-FSL-2355V	86	FSL	2355V	86FSL2355V	DI	N/C	Gas Sensor 20 Low Air Flow	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
241	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355W	86	AAH	2355W	86AAH2355W	DI	N/C	Gas Sensor 21 Methane High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
242	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355W	86	AAHH	2355W	86AAHH2355W	DI	N/C	Gas Sensor 21 Methane High-High Level	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
243	86PCM03	86-AC-2355.LCP	86-AE/AIT-2355W	86	XA	2355W	86XA2355W	DI	N/C	Gas Sensor 21 Fail	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
244	86PCM03	86-AC-2355.LCP	86-FSL-2355W	86	FSL	2355W	86FSL2355W	DI	N/C	Gas Sensor 21 Low Air Flow	Dewatered Biosolids Storage Bldg	Ground Floor	ALARM
245	94PCM02	94-AC-2124.LCP	94-AE/AIT-2124A	94	AAH	2124A	94AAH2124A	DI	N/C	Gas Sensor 1 H2S High Level	Wastewater Pump Station	Mazzanine Floor	ALARM
246	94PCM02	94-AC-2124.LCP	94-AE/AIT-2124A	94	AAHH	2124A	94AAHH2124A	DI	N/C	Gas Sensor 1 H2S High-High Level	Wastewater Pump Station	Mazzanine Floor	ALARM
247	94PCM02	94-AC-2124.LCP	94-AE/AIT-2124A	94	XA	2124A	94XA2124A	DI	N/C	Gas Sensor 1 Fail	Wastewater Pump Station	Mazzanine Floor	ALARM
248	94PCM02	94-AC-2124.LCP	94-AE/AIT-2124B	94	AAH	2124B	94AAH2124B	DI	N/C	Gas Sensor 2 Ammonia High Level	Wastewater Pump Station	Mazzanine Floor	ALARM
249	94PCM02	94-AC-2124.LCP	94-AE/AIT-2124B	94	AAHH	2124B	94AAHH2124B	DI	N/C	Gas Sensor 2 Ammonia High-High Level	Wastewater Pump Station	Mazzanine Floor	ALARM
250	94PCM02	94-AC-2124.LCP	94-AE/AIT-2124B	94	XA	2124B	94XA2124B	DI	N/C	Gas Sensor 2 Fail	Wastewater Pump Station	Mazzanine Floor	ALARM

AI: Analog In DI: Digital In DT: Data H/W-Hard-wired
AO:Analog Out DO: Digital Out DTS: Data I/O Mech: mechanical

SECTION 40 67 00
CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Related Specification Sections include but are not limited to:

1. Section 26 05 02 - Basic Electrical Requirements.
2. Section 26 05 04 - Basic Electrical Materials and Methods.
3. Section 40 76 00 - Process Gas Analytical Measurement.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI).
2. ASTM International (ASTM):
   a. B75, Standard Specification for Seamless Copper Tube.
3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. ICS 4, Industrial Control and Systems: Terminal Blocks.
4. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC):
      1) Article 409, Industrial Control Panels.
      2) Article 504, Intrinsically Safe Systems.
5. Underwriters Laboratories, Inc. (UL):
   a. 508A, Standard for Safety Industrial Control Panels.
   b. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.
   c. 913, Standard for Safety Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations.

1.03 DEFINITIONS

A. Panel: Control panels or enclosures listed in the schedule included in this Specification Section.
B. Foreign Voltages: Voltages that may be present in circuits when the panel main power is disconnected.
C. Intrinsically Safe:

1. A device, instrument or component that will not produce sparks or thermal effects under normal or abnormal conditions that will ignite a specified gas mixture.

2. Designed such that electrical and thermal energy limits inherently are at levels incapable of causing ignition.

D. Intrinsically Safe Circuit: A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under test conditions as prescribed in UL 913.
E. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.
F. Instrumentation Cable:

1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.
2. Instrumentation cable is typically either TSP (twisted-shielded pair) or TST (twisted-shielded triad), and is used for the transmission of low current or low voltage signals.

G. Ground Fault Circuit Interrupter (GFCI): A type of device (e.g., circuit breaker or receptacle) which detects an abnormal current flow to ground and opens the circuit preventing a hazardous situation.
H. Programmable Logic Controller (PLC): A specialized industrial computer using programmed, custom instructions to provide automated monitoring and control functions by interfacing software control strategies to input/output devices.
I. Remote Terminal Unit (RTU): An industrial data collection device designed for location at a remote site, that communicates data to a host system by using telemetry such as radio, dial-up telephone, or leased lines.
J. Input/Output (I/O): Hardware for the moving of control signals into and/or out of a PLC or RTU.
K. Supervisory Control and Data Acquisition (SCADA): Used in process control applications, where programmable logic controllers (PLCs) perform control functions but are monitored and supervised by computer workstations.
L. Digital Signal Cable: Used for the transmission of digital communication signals between computers, PLCs, RTUs, etc.
M. Uninterruptible Power Supply (UPS): A backup power unit that provides continuous power when the normal power supply is interrupted.
N. Loop Calibrator: Portable testing and measurement tool capable of accurately generating and measuring 4-20mA DC analog signals.

1.04 SUBMITTALS

A. Shop Drawings:

1. Table of contents sheet(s).
2. Legend and abbreviation sheets.
3. Panel exterior layout drawings.
4. Panel interior layout drawings.
5. Wiring diagrams.

6. Communication network drawing(s).
7. Bill of Material for each panel.
8. Panel door weight calculation.
9. Electrical load calculations for each panel.
10. Climate control calculations for each panel.

B. Product Data:

1. Manufacturer catalog cut sheets for enclosure, finish, panel devices, control auxiliaries, and accessories.

C. Contract Closeout Information:

1. Operation and Maintenance Data:
   a. See the Greenbook, the Whitebook, and Section 01 33 04 – Operations and Maintenance Manuals for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

D. Informational Submittals:

1. Unwitnessed Factory Testing confirmation of completion.
   a. Submittal shall list all required tests listed in Part 3 herein.
      1) Each test shall be checked off and signed by the appropriate personnel indicating that the test has been conducted and passed.
      2) If a test fails, include a new copy of test form for the re-tests.
      3) Submittal shall contain all failed, re-test, and pass test forms.
2. Record Drawings:
   a. Updated panel drawings delivered with the panel(s) from the Contractor's factory.
   b. Drawings shall be enclosed in transparent plastic and firmly secured within each panel.

1.05 SUBMITTAL DOCUMENTATION REQUIREMENTS

A. Shop Drawings:

1. Prepared with computer aided design (CAD) software.
2. Printed on 11 by 17 IN sheets.
3. Drawings shall include a title block containing the following:
   a. Plant or facility name where panel(s) are to be installed.
   b. Drawing title.
   c. Drawing number.
   d. Revision list with revision number and date

e. Drawing date.
f. Drawing scale.
g. Manufacturer name, address, and telephone number.

4. Cover sheet for each drawing set shall indicate the following:
   a. Plant or facility name.
   b. Project name.
   c. Submittal description.
   d. Revision number.
   e. Issue date.
5. Table of contents sheet(s) shall indicate the following for each drawing in the set:
   a. Drawing number.
   b. Drawing title.
   c. Sheet number.
6. Legend and abbreviation sheets shall indicate the following:
   a. Description of symbols and abbreviations used.
   b. Panel construction notes including enclosure NEMA rating, finish type and color, wire type, wire color strategy, conductor sizes, and wire labeling strategy.
   c. Confirmation that the panel(s) are to be affixed with a UL 508A or UL 698A label prior to shipment from the factory.
7. Bill of Material for each panel shall include the following component information:
   a. Instrument tag number.
   b. Quantity.
   c. Functional name or description.
   d. Manufacturer.
   e. Complete model number.
   f. Size or rating.
8. Panel exterior layout drawings to scale and shall indicate the following:
   a. Panel materials of construction, dimensions, and total assembled weight.
      1) All dimensions shall be in inches.
   b. Panel access openings.
   c. Conduit access locations.
      1) Ensure conduit entry locations allow for sufficient bend radius of field cables entering enclosure.
      2) Control panel exterior layout shall identify conduit and cable entry locations.
   d. Front view, side views and top view of enclosure.
   e. Front panel device layout.
   f. Nameplate schedule:
      1) Nameplate location.
      2) Nameplate dimensions.
      3) Legend which indicates text, letter height and color, background color and nameplate material.
      4) Include exterior legends as per UL requirements.

5) Short Circuit Current Rating (SCCR) marking per NFPA 70 or statement of exception. Include any required calculations.

g. Alarm annunciator window engraving schedule.
h. Layouts of graphic panels or mosaic displays.
i. Include a statement on the drawings that indicates that the panel has been built as per UL508A or UL698A standards.

9. Panel interior layout drawings shall be drawn to scale and shall indicate the following:
   a. Sub-panel or mounting pan dimensions.
      1) All dimensions shall be in inches.
   b. Interior device layouts indicating dimensioned location of devices.
   c. PLC/RTU general arrangement layouts.
   d. Wire-way locations, purpose, and dimensions. Include center line dimensions for all DIN rail and wire-way.
   e. Terminal strip designations.
   f. Location of external wiring and/or piping connections.
   g. Location of lighting fixtures, switches and receptacles.
   h. Include interior legends as per UL requirements.
10. Wiring diagrams shall consist of the following:
   a. Panel power distribution diagrams.
   b. Control and instrumentation wiring diagrams.
   c. PLC/RTU I/O information:
      1) Model number of I/O module.
      2) Description of I/O module type and function.
      3) Rack and slot number.
      4) Terminal number on module.
      5) Point or channel number.
      6) Programmed point addresses.
      7) Signal function and type.
   d. Internal network connections diagram
   e. Wiring diagrams shall identify each wire as it is to be labeled.
   f. Wiring diagrams shall include line/ rung references.
   g. Relay coils and their associated contacts shall be cross referenced to each other and clearly identified on the drawings.
   h. Wires leaving the sheet shall clearly indicate the continuation sheet and line/ rung references.
11. Communication network drawing(s) shall include:
   a. Network equipment
   b. Interconnections between all network equipment within the panel.
   c. Connection to the plant network.

B. Verify that panel door mounted equipment will not exceed the maximum allowed weight as per manufacturer's specification.

1. Submit panel door weight calculation. Include weight of computer if using a laptop shelf.

C. Electrical load calculations for each panel:

1. Panel current draw based on connected load.
2. SSCR Calculations.
3. UPS Run time calculations.
4. DC power supply load calculations.
5. Climate control calculations for each panel.
6. Verify that sufficient dissipation and/or generation of heat is provided to maintain interior panel temperatures within the rated operating temperatures of panel components.
7. Submit control panel heat release calculations (Watts or BTU/HR). Verify results with cooling/heating software. Submit heating and/or cooling equipment as required. Refer to Section 2.1.
8. Provide temperature monitoring switch when an air conditioner is required by heat release calculations. High Temperature switch shall be wired to a PLC discrete input for temperature monitoring.
9. Provide temperature monitoring switch when heater is required by heat release calculations. Low temperature switch shall be wired to a PLC discrete input for temperature monitoring.
10. Air conditioners shall have built-in temperature display.
11. Provide revision clouds and delta triangles to indicate changes for resubmittals.

1.06 QUALITY ASSURANCE

A. Approved supplier of Industrial Control Panels under provisions of UL 508A or UL 698A.

1. Entire assembly shall be affixed with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to shipment to the jobsite.
2. Control panel(s) without an affixed UL 508A or UL 698A label shall be rejected and sent back to the Contractor’s factory.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Enclosures:
   a. Hoffman Engineering Co.
   b. Hammond Manufacturing.
   c. Saginaw Control and Engineering.

d. Rittal.
e. Or equal.

2. Panel heaters:
   a. Hoffman Enclosures, Inc.
   b. Hammond Manufacturing.
   c. Rittal.
   d. Or equal.
3. Heat exchangers and air conditioners:
   a. Hoffman Engineering Co.
   b. Hammond Manufacturing.
   c. Saginaw Control and Engineering.
   d. Rittal
   e. Pfannenberg.
   f. Kooltronic.
   g. Or equal.
4. Cooling fans and exhaust packages:
   a. Hoffman Enclosures, Inc.
   b. Hammond Manufacturing.
   c. Saginaw Control and Engineering.
   d. Rittal
   e. Or equal.
5. Internal corrosion inhibitors:
   a. Hoffman Enclosures, Inc.; Model A-HCI10E
   b. Northern Technologies International Corporation (NTIC); Model Zerust VC.
   c. Cortec Corporation; Model VpCl Emitting Systems.
   d. Or equal.
6. Terminal Blocks:
   a. Quantity:
      1) For external connections
      2) Wire spare or unused cabinet mounted elements to their cabinets' terminal blocks.
   b. General: Group to keep 120V AC circuits separate from 24V DC circuits.
      1) Connection Type: Screw connection clamp.
      2) Compression Clamp:
         a) Hardened steel clamp with transversal grooves penetrating wire strands providing a vibration-proof connection
         b) Guides strands of wire into terminal
      3) Screws: Hardened steel, captive and self-locking.
      4) Current Bar: Copper or treated brass.
      5) Insulation:
         a) Thermoplastic rated for minus 55 to plus 110 degrees C.
         b) Two funnel shaped inputs to facilitate wire entry.
      6) Mounting:

a) Rail.
b) Terminal block can be extracted from an assembly without displacing adjacent blocks.
c) End Stops: One at each end of rail, minimum.

7) Wire Preparation: Stripping only.
8) Jumpers: Allow jumper installation without loss of space on terminal or rail.
9) Marking System:
a) Terminal number shown on both sides of terminal block
b) Allow use of preprinted and field marked tags
c) Terminal strip numbers shown on end stops
10) Mark terminal block and terminal strip numbers as required

c. Terminal Block, 120-Volt Power:
1) Rated Voltage: 600V AC
2) Rated Current: 30 amp
3) Wire Size: 22-10 AWG
4) Rated Wire Size: 10 AWG
5) Color: Gray body
6) Spacing: 0.25 inch, maximum
7) Manufacturer and Product: Entrelec; Type M4/6 or approved equal.

d. Terminal Block, Ground:
1) Wire Size: 22-12 AWG.
2) Rated Wire Size: 12 AWG
3) Color: Green and yellow body
4) Spacing: 0.25 inch, maximum
5) Grounding: Ground terminal blocks electrically grounded to the mounting rail
6) Manufacturer and Product: Entrelec; Type M4/6.P or approved equal.

e. Terminal Block, Blade Disconnect Switch:
1) Use: Provide one for each discrete input and output field interface wire.
2) Rated Voltage: 600V ac
3) Rated Current: 10 amp
4) Wire Size: 22-12 AWG
5) Rated Wire Size: 12 AWG
6) Color: Gray body, orange switch
7) Spacing: 0.25 inch, maximum
8) Manufacturer and Product: Entrelec; Type M4/6.SN or approved equal by Allen Bradley or Phoenix Contact

f. Terminal Block, Fused, 24V dc:
1) Rated Voltage: 600V dc
2) Rated Current: 6.3 amp
3) Wire Size: 22-12 AWG
4) Rated Wire Size: 12 AWG

5) Color: Gray body
6) Fuse: 5 by 20 GMA fuses
7) Fuse Marking: Fuse amperage rating shown on top of terminal block
8) Indication: LED diode 24V dc
9) Leakage Current: 5.2 mA, maximum
10) Spacing: 0.32 inch, maximum
11) Manufacturer and Product: Entrelec; Type M4/6.SFD or approved equal.
12) Terminal Block, Fused, 120V ac:
13) Rated Voltage: 600 V ac
14) Rated Current: 6.3 amp
15) Wire Size: 22-12 AWG
16) Rated Wire Size: 12 AWG
17) Color: Gray body
18) Fuse: 5 by 20 GMA fuses
19) Fuse Marking: Fuse amperage rating shown on top of terminal block
20) Indication: Neon lamp 110V ac
21) Leakage Current: 1.8 mA, maximum
22) Spacing: 0.32 inch, maximum
23) Manufacturer and Product: Entrelec; Type M4/6.SFL or approved equal by Allen Bradley of Phoenix Contact.

7. Grounding: Internal copper grounding bus for ground connections on cabinets, consoles, racks, and cabinets.
8. Intrinsic Safety Barriers:
   a. Intrinsically Safe Relays:
      1) Monitor discrete signals that originate in hazardous area and are used in a safe area.
      2) Rating: Power source shall be rated 24V dc or 120V ac as shown on Drawings, with not more than 250 volts available under fault conditions.
      3) Contact Rating: 5 amps, 250V ac.
      4) Mounting: DIN Rail.
      5) Manufacturer and Product: MTL, Inc.; Series MTL 2000. Or approved equal.
   b. Intrinsically Safe Barriers:
      1) Interface analog signals as they pass from hazardous area to safe area.
      2) Manufacturer and Product: MTL, Inc.; Series MTL 6000. Or approved equal.

2.02 ACCESSORIES

A. Panel Nameplates and Identification: See Section 26 05 02 (Basic Electrical Requirements).
B. Enclosures shall be provided with print pocket mounted on the interior of the door. Free standing enclosures shall have a minimum size print pocket of 12 inches.

C. All field instrument enclosure penetrations shall be plugged using threaded conduit plugs to prevent water or contaminant entry into the enclosure during installation.
D. Instruments shall maintain manufacturer's rating for the appropriate area designation.
E. Tape and/or plastic plugs shall not be an acceptable means of preventing water/contaminate intrusion.

2.03 FABRICATION

A. General:

1. Fabricate panels with instrument arrangements and dimensions identified in the Contract Documents.
2. Provide panel(s) with the required enclosure rating per NEMA 250 to meet classifications identified in the Contract Documents.
3. Devices installed in panel openings shall have a NEMA enclosure rating at least equal to the panel enclosure rating.
    a. Devices that cannot be obtained with an adequate NEMA rating shall be installed behind a transparent viewing window.
    b. The window shall maintain the required NEMA rating of the enclosure.
4. Externally mounted components including but not limited to air conditioners, enclosed transformers, external disconnect switches and external surge protector boxes shall match the NEMA rating and be constructed of the same material as the control panel. As an illustrative example, a NEMA 3/3R external enclosed transformer shall not be mounted on a NEMA 4X stainless steel panel.
5. Panel(s) shall be completely assembled at the Contractor's factory.
    a. No fabrication other than correction of minor defects or minor transit damage shall be performed on panels at the jobsite.
6. Painting:
    a. Panels fabricated from steel shall have their internal and external surfaces prepared, cleaned, primed, and painted.
        1) Mechanically abrade all surfaces to remove rust, scale, and surface imperfections.
        2) Provide final surface treatment with 120 grit abrasives or finer, followed by spot putty to fill all voids.
        3) Utilize solvent or chemical methods to clean panel surfaces.
        4) Apply surface conversion of zinc phosphate prior to painting to improve paint adhesion and to increase corrosion resistance.
        5) Electrostatically apply polyester urethane powder coating to all inside and outside surfaces.
        6) Bake powder coating at high temperatures to bond coating to enclosure surface.
            a) Panel exterior shall be ANSI #61 gray with flat finish.

7) Application of alkyd liquid enamel coating shall be allowed in lieu of polyester urethane powder for wall mounted NEMA 1 or NEMA 12 rated panels.

b. Panels fabricated from stainless steel, aluminum, or fiberglass shall not be painted.

7. Finish opening edges of panel cutouts to smooth and true surface conditions.
   a. Panels fabricated from steel shall have the opening edges finished with the panel exterior paint.
8. Panels shall meet all requirements of UL 508A or UL 698A.
   a. If more than one disconnect switch is required to disconnect all power within a panel or enclosure, provide a cautionary marking with the word "CAUTION" and the following or equivalent, "Risk of Electric Shock-More than one disconnect switch required to de-energize the equipment before servicing."
9. Provide control panel in accordance with NFPA 70, Article 409.
   a. In the event of any conflict between NFPA 70, Article 409 and UL 508A or UL 698A, the more stringent requirement shall apply.
10. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
    a. Determine the SCCR rating by one of the following methods:
       1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
       2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
       3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
    b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
    c. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

B. Wall Mounted Panels:

1. Seams continuously welded and ground smooth.
2. Rolled lip around all sides of enclosure door opening.
3. Gasketed dust tight.
4. Door clamps and hasp/staple for padlocking.
5. Key doors alike.
6. Continuous heavy GA hinge pin on doors.
   a. Hinges rated for 1.5 times door plus instrument weight.
7. Front full opening door.
8. Brackets for wall mounting.

C. Internal Panel Wiring:

1. Panel wire duct shall be installed between each row of components, and adjacent to each terminal strip.
    a. Route wiring within the panel in wire-duct neatly tied and bundled with tie wraps.
    b. Size wire ducts to include a minimum of 20% spare fill capacity.
    c. Wire-duct shall have removable snap-on covers and perforated walls for easy wire entrance.
    d. Wire-duct shall be constructed of nonmetallic materials with rating in excess of the maximum voltage carried therein.
2. Lay out panel wire-duct on both sides of each terminal strip. Leave one wire-duct empty, so the field wiring has sufficient room for entry into the panel through this wire-way. Designate the other wire-duct for panel wiring.
3. Utilize fiber optic and Ethernet cable management accessories within the panel.
    a. Terminate Ethernet cables from the field to RJ45 punch down blocks. Connect Ethernet patch cords from the RJ45 punch down block to the Ethernet switch.
    b. Terminate Fiber optic cable from field in fiber optic patch panel. Terminate all fibers within the cable. Connect Fiber optic patch cords from the fiber optic patch panel to the fiber optic Ethernet switch.
4. Wiring shall be installed such that if wires are removed from one device, source of power will not be disrupted to other devices.
5. “Daisy-chaining” of ground cables or power neutrals between equipment is not permitted.
6. Terminate all internal wiring with no more than two (2) conductors per terminal block point. For terminal strips designated for field wiring, only one side of the terminal strip shall be used for panel wiring.
7. Splicing and tapping of wires permitted only at terminal blocks.
8. Wire bundles to doors shall be secured at each end so that bending or twisting will be around longitudinal axis of wire.
    a. Protect bend area with sleeve.
9. Arrange wiring neatly, cut to proper length, with surplus wire removed.
    a. Arrange wiring with sufficient clearance.
    b. Provide abrasion protection for wire bundles that pass through openings or across edges of sheet metal.
10. To eliminate noise coupling or interference, AC power and control circuits shall be routed separate from analog signal cables, low voltage control circuits, and communications cables and digital signal cables.
    a. Separate by at least 6 IN, except at unavoidable crossover points and at device terminations.
    b. All wiring shall be bundled and supported by straps.

11. Separation of intrinsically safe circuit conductors and non-intrinsically safe circuit conductors:
    a. Secure conductors so that any intrinsically safe circuit conductor that might come loose from a terminal is unlikely to come into contact with another terminal.
    b. Separate non-intrinsically safe circuit conductors from intrinsically safe circuit conductors by one of the following methods:
        1) Separation of non-intrinsically safe circuit conductors from intrinsically safe circuit conductors by at least 2 IN (50 MM).
        2) Separation of non-intrinsically safe circuit conductors from intrinsically safe circuit conductors by use of a grounded metal partition 0.0359 IN (0.91 MM) or thicker.
        3) Separation of non-intrinsically safe circuit conductors from intrinsically safe circuit conductors by use of an approved insulating partition that extends to within 0.0625 IN (1.5 MM) of the enclosure walls.
        4) Where either (1) all of the intrinsically safe circuit conductors or (2) all of the non-intrinsically safe circuit conductors are in grounded metal-sheathed or metal-clad cables where the sheathing or cladding is capable of carrying fault current to ground.
    c. Blue wire-duct shall be used for wires carrying intrinsically safe circuit conductors.
12. Separate different intrinsically safe circuit conductors from each other by one of the following means:
    a. The conductors of each circuit are within a grounded metal shield.
    b. The conductors of each circuit have insulation with a minimum thickness of 0.01 IN (0.25 MM).
13. Provide minimum clearance of 0.125 IN (3 MM) between uninsulated parts of intrinsically safe field wiring conductors connected to terminals and grounded metal or other conducting parts.
14. Wiring to pilot devices or rotary switches shall be individually bundled and installed with a "flexible loop" of sufficient length to permit the component to be removed from panel for maintenance without removing terminations.
15. Conductors for AC and DC circuits shall be type MTW stranded copper listed for operation with 600 V at 90 DEGC.
    a. Conductor size shall be as required for load and 16 AWG minimum.
    b. Internal panel wiring color code:
        1) AC circuits:
            a) Power wiring: Black.
            b) Control interconnections: Red.
            c) Neutral: White.
            d) Ground: Green.

2) Low voltage DC circuits:
   a) Power wiring: Dark Blue(+) and White with Blue stripe.
   b) Control interconnections: Dark Blue.
3) Foreign voltage circuits: Yellow.
4) Annunciator circuits: Red.
5) Intrinsically safe circuits: Light Blue.

16. Analog signal cables shall be of 600 V insulation, stranded copper, twisted-shielded pairs.
    a. Conductor size: 18 AWG minimum.
    b. Terminate shield drain conductors to ground only at one end of the cable.
17. High precision 250 ohm resistors with 0.25 % accuracy shall be used where 4 - 20 mA DC analog signals are converted to 1 - 5 VDC signals.
    a. Resistors located at terminal strips.
    b. Resistors terminated using individual terminal blocks and with no other conductors.
    c. Resistor leads shall be un-insulated and of sufficient length to allow test or calibration equipment (e.g., HART communicator, loop calibrator) to be properly attached to the circuit with clamped test leads.
18. Analog signals for devices in separate enclosures shall not be wired in series.
    a. Loop isolators shall be used where analog signals are transmitted between control enclosures.
19. Wire and cable identification:
    a. Wire and cables numbered and tagged at each termination.
    b. Wire tags:
       1) See Section 40 90 00 (Instrumentation and Control for Process Systems).

D. Grounding Requirements:

1. Equipment grounding conductors shall be separated from incoming power conductors at the point of entry.
2. Minimize grounding conductor length within the enclosure by locating the ground reference point as close as practical to the incoming power point of entry.
3. Bond electrical racks, chassis and machine elements to a central ground bus.
   a. Nonconductive materials, such as paint, shall be removed from the area where the equipment contacts the enclosure.
4. Bond the enclosure to the ground bus. Bonded connections shall be free of paint and debris.
5. It is imperative that good electrical connections are made at the point between the ground bus and enclosure.

6. Panel-mounted devices shall be bonded to the panel enclosure or the panel grounding system by means of locknuts or pressure mounting methods.
7. Sub-panels and doors shall be bonded to ground.
8. Associated apparatus (connected to intrinsically safe circuits) and associated cable shields:
    a. Ground in accordance with the associated control drawing (drawing provided for the intrinsically safe circuit and which contains manufacturer's entity parameters).

E. Termination Requirements:

1. Wiring to circuits external to the panel connected to interposing terminal blocks.
2. Terminal blocks rigidly mounted on DIN rail mounting channels.
3. Electrical connections to terminal blocks shall be terminated with a proper torque tool as per manufacturer terminal block instructions. Terminating conductors without a torque tool can result in improper and unsafe installation.
4. Terminal strips located to provide adequate space for entrance and termination of the field conductors.
5. One side of each strip of terminal blocks reserved exclusively for the termination of field conductors.
6. Terminal block markings:
    a. Marking shall be the same as associated wire marking.
    b. Legible, machine-printed markings.
    c. Markings as identified in the shop drawings.
    d. Terminal block markings shall follow a consecutive numbering sequence. Terminal block numbers with a random numbering sequence are not acceptable.
7. Terminal block mechanical characteristics, and electrical characteristics shall be in accordance with NEMA ICS 4.
8. Terminal blocks with continuous marking strips.
    a. Each terminal block shall be identified with machine printed labels.
9. Terminals shall facilitate wire sizes as follows:
    a. 120 VAC applications: Conductor size 12 AWG minimum.
    b. Other: Conductor size 14 AWG minimum.
10. Analog signal cable shield drain conductors shall be individually terminated.
11. Install minimum of 20 % spare terminals.
12. Fused terminal blocks shall be used in the following circuits:
    a. Control voltage is used to energize a solenoid valve.
    b. DC power is connected to 2-wire, loop-powered instruments.
13. Fused terminal blocks shall be provided with blown fuse indicators.
14. When control circuits require more than one field conductor connected to a single wiring point, a sufficient number of terminal points shall be

connected internally to allow termination of only one field conductor per terminal block.

15. DIN rail mounting channels shall be installed along full length of the terminal strip areas to facilitate future expansion.
16. Connections to devices with screw type terminals shall be made using spade-tongue, insulated, compression terminators.
17. Intrinsically safe circuit termination:
    a. Provide at least 0.25 IN (6 MM) clearance between two terminals for connection of field wiring of different intrinsically safe circuits, unless this clearance is permitted to be reduced by the control drawing this is provided for the intrinsically safe circuit and which contains manufacturer's entity parameters.
    b. Identify intrinsically safe circuits at terminal and junction locations in a manner that is intended to prevent unintentional interference with the circuits during testing and servicing as required by NEC, Article 504.
    c. Terminal blocks used for intrinsically safe wires shall be blue.

F. Component Mounting and Placement:

1. Components shall be installed per manufacturer instructions.
2. Mount and wire so removal or replacement may be accomplished without interruption of service to adjacent devices.
3. Locate all devices mounted inside enclosures so terminals and adjustment devices are readily accessible without use of special tools and with terminal markings clearly visible.
4. Control relays and other control auxiliaries shall be mounted on DIN rail mounting channels where practical.
5. Front panel devices shall be mounted within a range of 40 to 70 IN above the finished floor, unless otherwise shown in the Contract Documents.
6. Locate power supplies with sufficient spacing for circulation of air.
7. Where components such as magnetic starters, contactors, relays, and other electromagnetic devices are installed within the same enclosure as the PLC/RTU system components, provide a barrier of at least 6 IN of separation between the "power area containing the electromagnetic devices" and the "control area".
8. Components mounted in the panel interior shall be fastened to an interior sub-panel using machine screws.
    a. Fastening devices shall not project through the outer surface of the panel enclosure.
9. Excess mounting space of at least 20 % for component types listed below to facilitate future expansion:
    a. Fuse holders.
    b. Circuit breakers.
    c. Control relays.
    d. Time delay relays.

e. Intrinsically safe barriers and relays.

10. Components installed on sub-panels shall be provides with a minimum spacing between component and wire duct of 1 IN.
    a. Minimum of 2 IN separation between terminal strips and wire ducts.
11. Pneumatic tubes and appurtenances:
    a. Connect panel air piping and tubing penetrations with bulkhead fittings.
    b. Pneumatic control tubing shall be 1/4 IN OD.
        1) Tubing material: Either soft annealed ASTM B75 copper or flame-resistant polyethylene.
    c. Main headers within panels shall be minimum 1 IN.
    d. Compression-type pressure fittings.
    e. Equip panel instrument leads with ball type isolation valve.
    f. Route tubing neatly and mount securely.
    g. Do not route tubing in front of or in wire ducting.
    h. Code terminal plates.
    i. Pneumatic devices shall be served by a dual function filter regulator.

G. Power Distribution:

1. Control panels powered by voltage greater than 120 VAC (nominal) main incoming power shall be provided with a disconnect switch mounted within the enclosure.
    a. Disconnect switch shall be interlocked with the enclosure door(s).
    b. Disconnect switches that supply motor loads shall comply with NEC Code part IX of article 430.
2. Main incoming power circuits shall be protected with a thermal magnetic circuit breaker.
    a. Limit load to maximum of 80 % of circuit breaker rating.
3. Component types listed below shall be individually fused so that they may be individually de-energized for maintenance:
    a. PLC/RTU power supply modules.
    b. Single-loop controllers.
    c. Operator interface terminals/HMI.
    d. DC power supplies.
    e. Alarm annunciators.
4. Each control panel with PLC/RTU components shall be furnished with power protection in the form of a double conversion UPS.
5. Equip each panel with necessary power supplies with ratings required for installed equipment and with minimum 25 % spare capacity.
6. Constant voltage transformers, balancing potentiometers, and rectifiers as necessary for specific instrument requirements.
7. Circuit breakers and fuses shall be used to protect equipment powered inside and outside enclosure
    a. Circuit breakers shall be UL489.

b. UL489 circuit breaker shall be finger safe.
c. Fuses shall be 1/4 x 1-1/4 IN size.

H. Internal Panel Lighting and Service Receptacles:

1. Panels less than or equal to 4 FT wide:
   a. One electrical GFCI duplex receptacle.
   b. One LED light fixture with manual switch(es).
2. Panels or panel faces greater than 4 FT wide:
   a. One duplex electrical GFCI receptacle per 6 FT of length.
   b. Continuous LED lighting strip with manual switches.

I. Environmental Controls:

1. Indoor panels located in a designated electrical room or control room:
   a. Thermostat controlled cooling fans with exhaust louvers if required to maintain temperature inside panel(s) below the maximum operating temperature rating of the internal components.
   b. Internal corrosion inhibitors.
2. Indoor panels not located within a designated electrical room or control room:
   a. Thermostat controlled heaters to maintain temperature approximately 10 DEGF above ambient for condensation prevention inside the panels.
   b. Automatically controlled, closed-loop heat exchangers or closed-loop air conditioners where required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the panel(s).
   c. Internal corrosion inhibitors.
3. Outdoor panels:
   a. Outdoor temperature range of 0 DEGF through 120 DEGF.
   b. Thermostat controlled heaters to maintain temperature approximately 10 DEGF above ambient dew point for condensation prevention inside the panels.
   c. Thermostat controlled closed-loop heat exchangers or closed-loop air conditioners if required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the panel.
   d. Internal corrosion inhibitors.
4. Environmental control components:
   a. Panel heaters:
      1) Thermostat controlled.
      2) Fan driven.
      3) Components mounted in an anodized aluminum housing.
      4) Designed for sub-panel mounting.

5) Powered from 120 VAC and protected with a dedicated circuit breaker.

b. Cooling fans and exhaust packages:
   1) Cooling fan with louver or grill and replaceable filter.
   2) Designed to be mounted within a panel cutout to provide positive airflow through the panel.
   3) Cooling fan and exhaust louvers shall be designed and listed to maintain a NEMA 12 enclosure rating.
   4) Fitted with replaceable, high-density foam or synthetic fiber.
   5) Cooling fan controlled with a separately mounted thermostat with bi-metal sensor and adjustable dial for temperature setting.
   6) Powered from 120 VAC and protected with a dedicated circuit breaker.

c. Heat exchangers and air conditioners:
   1) Dual-loop design to isolate panel interior air from exterior air.
   2) Thermostat controlled.
   3) Operate from 120 VAC and protected with a dedicated circuit breaker.

d. Internal corrosion inhibitors:
   1) Contains chemical which vaporizes and condenses on surfaces in the enclosure.
   2) Inhibitor shall be applied in accordance with manufacturer instructions for the enclosure volume.
   3) Inhibitor shall be applied in the panel(s) prior to shipment from the Contractor's factory.

2.04 UNWITNESSED FACTORY TESTING

A. Inspect and test entire panel assembly to verify readiness for shipment.

   1. Location: Panel fabricator's factory.

B. Tests shall be fully documented and signed by the panel fabricator's factory supervisor.

   1. Submit results of Unwitnessed Factory Testing as a submittal for approval.

C. The panel shop shall fully test the control panel for correct wiring.

   1. Each I/O point shall be checked by measuring or connecting circuits at the field terminal blocks.

D. Burn-in test: Panel(s) shall be fully energized for a minimum period of 48 HRS.

E. Testing equipment (such as digital multi-meters, analog loop calibrators, and laptop computers with PLC programming software) shall be used as required for testing.

F. The following functions shall be tested as a minimum:

1. Verify functions of the panel(s) required by the Contract Documents.
2. Correctness of wiring from all panel field terminals to all I/O points and to all panel components.
3. Simulate and test each discrete signal at the field terminal strips.
4. Simulate and test each analog signal using loop calibrators.
5. Correct operation of communications between PLC system Central Processing Units (CPUs) and Remote I/O bases.
6. Correct operation of single-loop controllers (including digital communication to microprocessor based devices).
7. Correct operation of all digital communication devices.
8. Verify online and offline diagnostic tests and procedures.
9. Deficiencies shall be corrected prior to requesting the Engineer and/or Owner to attend factory testing if specified, or prior to shipment from the Contractor's factory.

2.05 MAINTENANCE MATERIALS

A. Extra Materials:

1. Quantity of 25 % replacement lamps for each type installed (minimum of 12 of each type).
2. Minimum 12 replacement filters for each type installed.
3. 1 QT of exterior finish touch-up paint.
4. One complete set of replacement corrosion inhibitors in sealed packages for each panel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Anchor panels in a manner to prevent the enclosure from racking, which may cause the access doors to become misaligned.
B. Obtain approved panel layouts prior to installation of conduits.
C. Install products in accordance with manufacturer's instructions.

END OF SECTION

SECTION 40 76 00
PROCESS GAS ANALYTICAL MEASUREMENT

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Related Specification Sections include but are not limited to:

1. Section 26 05 02 - Basic Electrical Requirements.
2. Section 26 05 04 - Basic Electrical Materials and Methods.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Gas Association (AGA):
   a. Gas Measurement Committee Report #3.
2. American Iron and Steel Institute (AISI).
3. American National Standards Institute (ANSI).
4. American Society of Mechanical Engineers (ASME):
   a. B16.5, Pipe Flanges and Flanged Fittings.
   b. B31.1, Power Piping.
   c. PTC 19.3, Instruments and Apparatus, Part 3 Temperature Measurement.
   d. PTC 19.5, Application of Fluid Meters, Part 2.
   e. Section II, Part A SA-182, Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
   f. Section II, Part A SA-479, Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
5. ASTM International (ASTM):
   a. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
   b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   c. A182, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
   d. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
   e. A276, Standard Specification for Stainless Steel Bars and Shapes.
   f. A479, Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
   g. B16, Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
   h. B75, Standard Specification for Seamless Copper Tube.

i. B124, Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes.
j. B283, Standard Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed).
k. B453, Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Rod, Bar, and Shapes.

6. The International Society of Automation (ISA):
   a. MC96.1, Temperature Measurement Thermocouples.
7. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 SUBMITTALS

A. Action Submittals:

1. Product Data: Products listed in Part 2.

PART 2 PRODUCTS

2.01 COMBUSTIBLE AND TOXIC GAS DETECTORS:

A. Acceptable manufacturers:

1. Diffusion type sensors:
   a. MSA Instruments.
   b. Bacharach.
   c. Draeger.
   d. Sierra Monitor.
   e. Or equal.
2. Sample draw systems:
   a. MSA TriGas.
   b. Or equal.
3. Open path type sensors:
   a. MSA Ultima OPIR-5.
   b. Or equal.

B. Control unit:

1. Front mounted indication.
   a. Minimum three-digit display of gas concentration associated with each sensor.
   b. Alarm status indicators for each gas sensing channel:
      1) Trouble.
      2) High gas level detected.
      3) High high gas level detected.

2. Alarm relay outputs:

a. "System trouble"(Fail) contact to indicate trouble in the event any of the following conditions are true:
   1) System power loss.
   2) Signal loss from any sensor.
   3) Signal out of appropriate range.
   4) Control module malfunction or removal.

b. Each output contact shall be Form C, DPDT, rated for 3 amps resistive at 120 VAC.
c. Output signals: 4-20 mA signal representing gas concentration for each gas sensor.
d. Temperature range: 32 to 140 DEGF.
e. Relative humidity range: 0-95% non-condensing.

C. Sensor and transmitter design and fabrication:

1. Sensor mounting type shall be as indicated on schedule: Either diffusion mounted (point type) or sample draw mounted.
2. Combustible gas sensor shall be catalytic bead type with demonstrated resistance to poisoning by silicones and hydrogen sulfide gases.
3. Sensor: Utilize infrared absorption technique, impervious to gas poisoning
4. Toxic gas sensor shall be the electrochemical type and shall not require the periodic addition of reagents.
5. Interconnect wiring from sensor to transmitter (if not integral) or control unit shall be 3-wire shielded cable.
6. Sensing element shall have minimum useful life of one year.
7. Transmitter output: 4-20 mA signal proportional to measured gas level.
   a. Capable of driving 600 ohm load at 24 VDC supply voltage.
8. Accuracy:
   a. Combustible gas detection:
      1) +3% LEL to 50% full scale.
      2) +5% LEL, 50 to 100% full scale.

   b. Toxic gas detection:
      1) +10% full scale or 2 PPM, whichever is greater.

9. Environmental:
   a. Ambient operating temperature: -40 to 158 DEGF.
   b. Relative humidity: 0-95% non-condensing.
10. Housing: In accordance with the area classification shown on Drawings.
11. Provide nonintrusive means of calibration.
12. Local displays:
   a. 3-1/2 digit LCD or LED display of measured gas level.
   b. Fault LED.
13. Standalone sensors and transmitters (without central control unit):

a. Provide relay contacts rated at 1/2 amps at 120 VAC for each of the following conditions:
   1) High gas level (warning level).
   2) High high gas level (alarm level).
   3) Sensor fault condition.

14. Relay contacts shall be normally energized (normally closed); contacts shall open in the event of a warning, alarm or trouble condition.
15. Minimum detector response time when exposed to 100% LEL gas concentration:
    a. 10 seconds to 50% LEL.
    b. 30 seconds to 90% LEL.
16. Store calibration data in nonvolatile memory or back up with battery.

D. Provide one calibration kit for each type of gas monitored.

1. Calibration kits shall be furnished complete with all tubing, regulators, fittings, communication devices, and accessories required to calibrate sensors.
2. Calibration kit shall utilize nonintrusive means of calibrating sensors/transmitters.

DI. Provide two full cylinders of each type of calibration check gas.

1. Cylinder size: 17 liters.

DII. Provide the same quantity of zero air cylinders as the total required number of calibration check gas cylinders (of all types).

DIII. Sample draw systems:

1. Sample draw systems shall be manufactured as a complete unit and shall contain the following:
   a. Enclosure: See Section 40 67 00 (Control System Equipment Panels and Racks).
   b. Compressed air aspirator or motorized pump to draw a sample past the sensor.
      1) Pump shall be of the sample draw type capable of drawing a sample from up to 150 feet and capable of supplying a gas sample for up to two gas sensor / transmitters.

   c. Flow switch to provide annunciation of low sample flow rate with dry contact for remote monitoring.
      1) Provide indicator light on panel for low air flow.

   d. Rotameter giving visual indication of flow through the panel.
   e. Normal operation sample inlet and calibration inlet.
   f. 3-way calibration valve.
   g. End-line filter located at panel.

h. Diffusion type sensors, quantity as required. System shall be capable of up to two sensors connected in series.
i. 120VAC to 24VDC power supply.
   1) Capable of accepting wire gauge size indicated on the Drawings.
   2) Provide terminal blocks as required to terminate incoming wires to power supply.

j. Minimum Class 1, Division 2 rated.
k. Panel mounting brackets are provided to allow mounting of the enclosure to a flat surface.
l. Non-intrusive Calibration Capability. All sensor/transmitters can be calibrated without opening any enclosures via through glass push buttons, Bluetooth connection, or HART communications.
   1) The sensor/transmitter will not be affected by low level ambient light either natural or man made.

   2) The display of the sensor/transmitter will instruct the user when to apply zero and span gas. The sensor/transmitter will automatically adjust its internal settings to the proper calibration values without further intervention by the user. Upon completion of a successful calibration, the sensor transmitter will exit the calibration mode. Date stamp of last successful calibration will be retained in the sensor/transmitter internal memory, with capability to be displayed on the LED display.

   3) In the event of an unsuccessful calibration for any reason, the sensor/transmitter display must show an unsuccessful calibration and revert to its previous calibration setting.

   4) Use of flashlight type devices, magnets or clamp-on devices to achieve calibration is not acceptable. The acceptable method uses a transmitter that employs through glass push buttons, Bluetooth connection, or HART Communications.

2.02 ACCESSORIES

A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.

   1. Materials, unless otherwise specified, shall be as follows:
      a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.
      b. Mounting brackets: 316 stainless steel.
      c. Mounting plates, angles: 316 stainless steel.
      d. Instrument pipe stands: 316 stainless steel.

B. Cable lengths between sensors and transmitters shall be continuous (without splices) and as required to accommodate locations as shown on Drawings.

C. Provide sample tubing sample draw type systems.

1. Materials: Per manufacturer’s recommendations.
2. Size: Per manufacturer’s recommendations.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Instrument Mounting:

1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
3. Mount instruments level, plumb, and support rigidly.
4. Mount to provide:
   a. Protection from heat, shock, and vibrations.
   b. Accessibility for maintenance.
   c. Freedom from interference with piping, conduit and equipment.

C. Separately mounted diffusion type sensors:

1. Installation height per manufacturer’s recommendations for the gas type being monitored.
2. Sensor shall be installed at a location such that it is accessible for maintenance.
   a. Do not install behind piping, conduits, or other utilities.

D. Instrument Valves:

1. Orient stems for proper operation.
2. Install arrays orderly and neat in appearance with true horizontal and vertical lines.
3. Provide a minimum of 2 IN clearance between valve handle turning radii where there are multiple valve handles appearing in a straight line.
4. Valves shall have bonnets and any soft seals removed during welding or soldering into the line.
   a. When cool, reassemble the valves.
5. Support each valve individually.
   a. The tubing system does not qualify as support for the valve.

6. Locate instrument piping and tubing so as to be free of vibration and interference with other piping, conduit, or equipment.
7. Keep foreign matter out of the system.
8. Remove all oil on piping and tubing with solvent before piping and tubing installation.
9. Plug all open ends and connections to keep out contaminants.

E. Tubing Installation:

1. General:
   a. Install such that tube shows no sign of crumpling, bends of too short a radius, or flattening, etc.
   b. Make tube runs straight and parallel or perpendicular to the floor, equipment and piping runs.
   c. Slope continuously from the instrument to the process with a minimum slope of 0.50 IN per foot.
   d. If the sensing line cannot be continuously sloped, install high point vents and low point drains.
   e. Keep instrument tubing clean during all phases of work.
   f. Blow out with clean, dry, oil-free air immediately before final assembly.
   g. Cut by sawing only and debur.
   h. Maximum length of sample tubing for sample draw systems: 100 feet.
   i. Tubing is shown diagrammatically on the Drawings. Contractor shall make field adjustments as necessary to construct a complete system, avoid conflicts with existing and new utilities, provide sufficient clearances, and provide sufficient access.
      1) Additional tubing required to achieve field routing shall be at no additional cost.

   j. Supports are not shown on the Drawings. Provide supports, fittings, and other ancillary equipment as required.
      1) Additional supports, fittings, or other ancillary equipment not shown on the Drawings shall be at no additional cost.

2. Bending:
   a. Make each bend with tube bender of the correct size for the tube.
   b. Make all bends smooth and continuous.
   c. Rebending is not permitted.
   d. Make bends true to angle and radius.
   e. Maintain a true circular cross section of tubing without buckling or undue stretch of tube wall.
3. Tubing support:
   a. Intermittently support by clamping to support angle.

b. Install supports to be self-draining, supported by hangers, or cantilevered from walls or structural beams.
c. Support at 5 FT-0 IN maximum spans for horizontal or vertical runs.
d. Use tubing trays in areas where spans between supports are greater than 5 FT and for all signal tubing support.
e. Support each tubing tray at 10 FT maximum spans.
f. Align tubing in orderly rows and retain in the tray by bolted clips.
    1) The use of spring or speed clips is not acceptable.

g. Maintain order of the tubing throughout the length of the tray.
h. Locate angle, channel and tray installation to protect tubing from spills and mechanical damage.
i. Locate support members to clear all piping, conduit, equipment, hatchways, monorails, and personnel access ways and allow access for equipment operation and maintenance.
j. Support trays to prevent torsion, sway or sag.
k. Permanently attach supports to building steel or other permanent structural members.
l. Arrange supports and trays so that they do not become a trough or trap.

4. Routing and orientation:
    a. Route to maintain a minimum headroom clearance of 8 FT.
    b. Locate and orient valves and specialties so that they are accessible for operation and maintenance from the operating floor.
        1) Do not route through or over equipment removal areas, below monorails or cranes nor above or below hatches.

    c. Expansion and vibration provisions:
        1) Provide horizontal expansion loops at the process connections.
        2) Route tubing parallel to relative motion through sleeved supports that allow linear tube movement.
        3) Cold springing of tubing to compensate for thermal expansion is prohibited.
        4) Utilize flexible hoses to connect pneumatic tubing to air users which may move or vibrate.

F. Threaded Connection Seals:

1. Use Tite-Seal or acceptable alternate.
2. Use of lead base pipe dope or Teflon tape is not acceptable.
3. Do not apply Tite-Seal to tubing threads of compression fittings.

3.02 SCHEDULE

A. Schedule:

TAG NO	AREA	LOCATION	GAS	MOUNT TYPE	RANGE
19-AE/AIT-2100A	19 (Electric Yard)	Main Plant Switchgear Building	Methane	D	0-100% LEL
19-AE/AIT-2100B	19 (Electric Yard)	Main Plant Switchgear Building	Methane	D	0-100% LEL
51-AE/AIT-2110A	51 (Operations)	Perimeter	Methane	IR	0-100% LEL
51-AE/AIT-2110B	51 (Operations)	Perimeter	Methane	IR	0-100% LEL
51-AE/AIT-2110C	51 (Operations)	Perimeter	Methane	IR	0-100% LEL
51-AE/AIT-2110D	51 (Operations)	Perimeter	Methane	IR	0-100% LEL
51-AE/AIT-2110E	51 (Operations)	Roof	Methane	D	0-100% LEL
51-AE/AIT-2110F	51 (Operations)	Roof	Methane	D	0-100% LEL
51-AE/AIT-2110G	51 (Operations)	Roof	Methane	D	0-100% LEL
60-AE/AIT-2500A	60 (Chemical)	Pump Room	Methane	SP	0-100% LEL
60-AE/AIT-2500B	60 (Chemical)	Aging and Storage Tanks Area	Methane	SP	0-100% LEL
70-AE/AIT-2100A	70 (Energy)	Boiler Room	Methane	D	0-100% LEL
70-AE/AIT-2100B	70 (Energy)	Boiler Room	Methane	D	0-100% LEL
76-AE/AIT-2350A 76-AE/AIT-2350B	76 (Centrifuge)	Grit Loading Area, Ground Floor	Methane Ammonia	SP (2 sensor)	0-100% LEL 0-100 ppm
76-AE/AIT-2350C	76 (Centrifuge)	Grit Loading Area, Ground Floor	Hydrogen Sulfide	D	0-50 ppm
76-AE/AIT-2350D 76-AE/AIT-2350E	76 (Centrifuge)	Grit Loading Area, Second Floor	Methane Ammonia	SP (2 sensor)	0-100% LEL 0-100 ppm
76-AE/AIT-2350F	76 (Centrifuge)	Grit Loading Area, Second Floor	Hydrogen Sulfide	D	0-50 ppm
76-AE/AIT-2350G	76 (Centrifuge)	Chemical Area	Methane	SP	0-100% LEL
76-AE/AIT-2355A	76 (Centrifuge)	Ground Floor	Methane	SP	0-100% LEL
76-AE/AIT-2355B	76 (Centrifuge)	Ground Floor	Methane	SP	0-100% LEL
76-AE/AIT-2355C	76 (Centrifuge)	Ground Floor	Methane	SP	0-100% LEL
76-AE/AIT-2355D	76 (Centrifuge)	Ground Floor	Methane	SP	0-100% LEL
76-AE/AIT-2355E	76 (Centrifuge)	Ground Floor	Methane	SP	0-100% LEL
76-AE/AIT-2355F	76 (Centrifuge)	Ground Floor	Methane	SP	0-100% LEL
76-AE/AIT-2355G	76 (Centrifuge)	Ground Floor	Methane	SP	0-100% LEL
76-AE/AIT-2355H	76 (Centrifuge)	Second Floor – Lab	Methane	D	0-100% LEL
76-AE/AIT-2355J	76 (Centrifuge)	Second Floor - Op Control Room	Methane	D	0-100% LEL
76-AE/AIT-2355K	76 (Centrifuge)	Third Floor	Methane	SP	0-100% LEL

TAG NO	AREA	LOCATION	GAS	MOUNT TYPE	RANGE
76-AE/AIT-2355L	76 (Centrifuge)	Third Floor	Methane	SP	0-100% LEL
76-AE/AIT-2355M	76 (Centrifuge)	Third Floor	Methane	SP	0-100% LEL
80-AE/AIT-2500A	80 (Digesters)	Tunnels	Methane	SP	0-100% LEL
80-AE/AIT-2500B	80 (Digesters)	Tunnels	Methane	SP	0-100% LEL
80-AE/AIT-2500C	80 (Digesters)	Tunnels	Methane	SP	0-100% LEL
80-AE/AIT-2500D	80 (Digesters)	Tunnels	Methane	SP	0-100% LEL
80-AE/AIT-2500E	80 (Digesters)	Tunnels	Methane	SP	0-100% LEL
80-AE/AIT-2500F	80 (Digesters)	Tunnels	Methane	SP	0-100% LEL
80-AE/AIT-2500G	80 (Digesters)	Tunnels	Methane	SP	0-100% LEL
80-AE/AIT-2500H	80 (Digesters)	Tunnels	Methane	SP	0-100% LEL
80-AE/AIT-2500J	80 (Digesters)	Tunnels	Methane	SP	0-100% LEL
80-AE/AIT-2500K	80 (Digesters)	Electrical Room	Methane	D	0-100% LEL
86-AE/AIT-2350A	86 (Dewatered Biosolids Storage)	Ground Floor	Hydrogen Sulfide	D	0-50 ppm
86-AE/AIT-2350B	86 (Dewatered Biosolids Storage)	Ground Floor	Carbon Monoxide	D	0-100 ppm
86-AE/AIT-2350C	86 (Dewatered Biosolids Storage)	Ground Floor	Hydrogen Sulfide	D	0-50 ppm
86-AE/AIT-2350D	86 (Dewatered Biosolids Storage)	Ground Floor	Carbon Monoxide	D	0-100 ppm
86-AE/AIT-2355A	86 (Dewatered Biosolids Storage)	Tunnels	Methane	SP	0-100% LEL
86-AE/AIT-2355B	86 (Dewatered Biosolids Storage)	Tunnels	Methane	SP	0-100% LEL
86-AE/AIT-2355C	86 (Dewatered Biosolids Storage)	Tunnels	Methane	SP	0-100% LEL
86-AE/AIT-2355D	86 (Dewatered Biosolids Storage)	Tunnels	Methane	SP	0-100% LEL
86-AE/AIT-2355E	86 (Dewatered Biosolids Storage)	Tunnels	Methane	SP	0-100% LEL
86-AE/AIT-2355F	86 (Dewatered Biosolids Storage)	Tunnels	Methane	SP	0-100% LEL
86-AE/AIT-2355G	86 (Dewatered Biosolids Storage)	Tunnels	Methane	SP	0-100% LEL
86-AE/AIT-2355H	86 (Dewatered Biosolids Storage)	Tunnels	Methane	SP	0-100% LEL
86-AE/AIT-2355J	86 (Dewatered Biosolids Storage)	Tunnels	Methane	SP	0-100% LEL
86-AE/AIT-2355K	76 (Centrifuge)	Tunnels	Methane	SP	0-100% LEL
86-AE/AIT-2355L	76 (Centrifuge)	Tunnels	Methane	SP	0-100% LEL
86-AE/AIT-2355M	76 (Centrifuge)	Tunnels	Methane	SP	0-100% LEL
86-AE/AIT-2355N	86 (Dewatered	Tunnels	Methane	SP	0-100% LEL

TAG NO	AREA	LOCATION	GAS	MOUNT TYPE	RANGE
	Biosolids Storage)				
86-AE/AIT-2355P	86 (Dewatered Biosolids Storage)	Ground Floor	Methane	SP	0-100% LEL
86-AE/AIT-2355Q 86-AE/AIT-2355R	86 (Dewatered Biosolids Storage)	Ground Floor	Methane Ammonia	SP (2 sensors)	0-100% LEL 0-100 ppm
86-AE/AIT-2355S 86-AE/AIT-2355T	86 (Dewatered Biosolids Storage)	Ground Floor	Methane Ammonia	SP (2 sensors)	0-100% LEL 0-100 ppm
86-AE/AIT-2355U	86 (Dewatered Biosolids Storage)	Ground Floor	Methane	SP	0-100% LEL
86-AE/AIT-2355V	86 (Dewatered Biosolids Storage)	Ground Floor	Methane	SP	0-100% LEL
86-AE/AIT-2355W	86 (Dewatered Biosolids Storage)	Ground Floor	Methane	SP	0-100% LEL
94-AE/AIT-2124A	94 (Wastewater Pump Station)	Wet Well Room	Hydrogen Sulfide	D	0-50 ppm
94-AE/AIT-2124B	94 (Wastewater Pump Station)	Wet Well Room	Ammonia	D	0-100 ppm

MOUNT TYPE: D – diffusion (point) type, IR – infrared, SP – single point sample draw.

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SECTION 40 90 00
INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Major Work Items: Includes but is not limited to engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and training for complete Process Instrumentation and Control (PIC).

1. Process instrumentation including primary elements, transmitters, control devices, and control panels.
2. Contractor shall be responsible for integration of new systems with existing DCS.
   a. I/O shall use existing conductors for connection to DCS. Prior to reusing existing conductors, Contractor shall perform continuity testing per Section 26 08 00 (Commissioning of Electrical Systems).
   b. Contractor shall provide I/O loop drawings to show updates to existing DCS connections.
      1) Owner will provide programming updates of DCS system.
   c. See Section 40 61 93 (Process Control System Input-Output List) for I/O list.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section and other PIC subsections:

1. American National Standards Institute (ANSI).
2. ASTM International (ASTM):
   a. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
   b. A276, Standard Specification for Stainless Steel Bars and Shapes.
   c. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
   d. B32, Standard Specification for Solder Metal.
   e. B88, Standard Specification for Seamless Copper Water Tube.
3. Deutsche Industrie-Norm (DIN): VDE 0611, Specification for modular terminal blocks for connection of copper conductors up to 1,000V ac and up to 1,200V dc.
4. Institute of Electrical and Electronics Engineers, Inc. (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

5. International Society of Automation (ISA):
    a. RP12.06.01, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation Part 1: Instrinsic Safety.
    b. S5.1, Instrumentation Symbols and Identification.
    c. S5.4, Instrument Loop Diagrams.
    d. S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.
    e. TR20.00.01, Specification Forms for Process Measurement and Control Instruments, Part 1: General.
6. International Conference on Energy Conversion and Application (ICECA).
7. National Electrical Code (NEC).
8. National Electrical Manufacturers Association (NEMA):
    a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
    b. ICS 1, Industrial Control and Systems General Requirements.
9. National Fire Protection Association (NFPA): 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
10. NSF International (NSF):
    a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
    b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
11. Underwriters Laboratory, Inc. (UL): 508A, Standard for Safety, Industrial Control Panels.

1.03 DEFINITIONS

A. Abbreviations:

1. CAT: Component Acceptance Test
2. DCS: Distributed Control System
3. FDT: Factory Demonstration Test.
4. HMI: Human-Machine Interface.
5. HVAC: Heating, Ventilating, and Air Conditioning.
6. I&C: Instrumentation and Control.
7. I/O: Input and Output.
8. NIP: Network Interface Panel.
9. O&M: Operation and Maintenance.
10. P&ID: Process and Instrument Diagram.
11. PIC: Process Instrumentation and Control.
12. PLC: Programmable Logic Controller.
13. SAT: Site Acceptance Test
14. SCADA: Supervisory Control and Data Acquisition.

B. Enclosure: Control panel, console, cabinet, or instrument housing.

C. Instructor Day: Eight hours of actual instruction time.

D. Standard Software: Software packages that are independent of Project on which they are used. Standard software includes system software, supervisory control, and data acquisition (SCADA) software.

1. System Software: Application independent (non-project specific) software developed by digital equipment manufacturers and software companies. Includes, but is not limited to, operating systems; network support, programming languages (C, C++, Visual C++, BASIC, Visual Basic, etc.); Office Suites (word processor, spreadsheet, database, etc.); e-mail; security (firewall, antivirus; spam, spyware, etc.) debugging aids; and diagnostics.
2. SCADA Software: Software packages independent of specific process control project on which they are used. Includes, but is not limited to, providing configuring and run-time capability for, data acquisition (I/O driver, OPC servers, etc.), monitoring, alarming, human-machine interface, supervisory control, data collection, data retrieval, trending, report generation, control, and diagnostics.
3. Controller Programming Software: Software packages for the configuring of PLCs, RTUs, DCUs, SLDC, and fieldbus devices.

E. Application Software: Software to provide functions unique to this Project and that are not provided by standard software alone, including but not limited to:

1. Configuring databases, tables, displays, historians, reports, parameter lists, ladder logic, function block, and control strategies required to implement functions unique to this Project.
2. Programming in any programming or scripting language.

F. Rising/Falling: Define action of discrete devices about their setpoint.

1. Rising: Contacts close when an increasing process variable rises through setpoint.
2. Falling: Contacts close when a decreasing process variable falls through setpoint.

G. Signal Types:

1. Analog Signal, Current Type:
   a. 4 to 20 mA dc signals conforming to ISA S50.1.
   b. Unless otherwise indicated for specific PIC subsection components, use the following ISA S50.1 options.
      1) Transmitter Type: Number 2, two-wire.
      2) Transmitter Load Resistance Capacity: Class L.

3) Fully isolated transmitters and receivers.

2. Analog Signal, Voltage Type: 1 to 5 volts dc within panel where common high precision dropping resistor is used.
3. Digital Bus, a communication network, such as Profibus, Foundation Fieldbus, or DeviceNet, allowing instruments and devices to transmit data, control functions, and diagnostic information.
4. Discrete signals, two-state logic signals using dc or 120V ac sources as indicated.
5. Pulse Frequency Signals:
   a. Direct-current pulses whose repetition rate is linearly proportional to process variable.
   b. Pulses generated by contact closures or solid state switches.
   c. Power source less than 30V dc.
6. Special Signals: Other types of signals used to transmit analog and digital information between field elements, transmitters, receivers, controllers, and digital devices.

1.04 SYSTEM DESCRIPTION

A. General Requirements:

1. Provide the complete operating PIC to perform the specified monitoring, communications, alarm, control, display, and reporting functions in accordance with the SCADA requirements.
2. It is the intent of these specifications that the entire electrical power, instrumentation, and control system be complete and operable. Provide all necessary material and labor for the complete system, from source of power to final utilization equipment, including all connections, testing, and calibration of all equipment furnished by others, as well as equipment furnished by Contractor, whether or not specifically mentioned, but which are necessary for successful operation.

B. Design Requirements:

1. Detailed Wiring Design: Complete detailed design of PIC components and PIC drawings, including detailed control panel layouts, detailed NIP layouts, panel power distribution drawings, and loop wiring diagrams.
2. Provide consistent hardware and software functions for PIC. For example, provide functions in control logic, sequence controls, and display layout in same or similar manner.

C. Commissioning Requirements:

1. Verify readiness for operation.
2. Verify correctness of final power and signal connections.
3. Starting up.
4. Testing and coordination of testing.

5. Training.
6. See Part 3 for additional details.

1.05 SUBMITTALS

A. General:

1. Submit proposed submittal breakdown consisting of sequencing and packaging of information in accordance with Project Schedule.
2. Partial Submittals not in accordance with Project Schedule will not be accepted.
3. Submittal Format:
   a. Hard Copy: Required for all submittals.
   b. Electronic Copies: Required, unless otherwise noted for specific items.
      1) Manufacturers' Standard Documents: Adobe Acrobat PDF.
      2) Documents created specifically for Project:
         a) Text and Graphics: Microsoft Word.
         b) Lists: Microsoft Excel, unless otherwise noted for specific items.
         c) Drawings: AutoCAD.
4. Identify proposed items, options, installed spares, and other provisions for future work (for example, reserved panel space; unused components, wiring, and terminals).
5. Legends and Abbreviation Lists:
   a. Definition of symbols and abbreviations used; for example, engineering units, flowstreams, instruments, structures, and other process items used in nameplates, legends, data sheets, point descriptions, HMI displays, alarm/status logs, and reports.
   b. Use identical abbreviations in PIC subsections.
   c. Submit updated versions as they occur.
6. Activity Completion:
   a. Action Submittals: Completed when reviewed and approved.
   b. Informational Submittals: Completed when reviewed and found to meet conditions of the Contract.
7. All shop drawings shall include a City-approved title block. The title block shall include, as a minimum, business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing. Loop Drawing Submittals shall be submitted in accordance with the contract documents.

B. Action Submittals:

1. Bill of Materials: List of required equipment.
   a. Group equipment items by enclosure and field, and within an enclosure, as follows:

1) PIC Components: By component identification code.
2) Other Equipment: By equipment type.

b. Data Included:
1) Equipment tag number.
2) Description.
3) Manufacturer, complete model number and all options not defined by model number.
4) Quantity supplied.
5) Component identification code where applicable.
6) For panels, include panel reference number and name plate inscription.

c. Formats: Hard copy and Microsoft Excel.

2. Catalog Cuts: I&C components, electrical devices, and mechanical devices:
a. Catalog information, marked to identify proposed items and options.
b. Descriptive literature.
c. External power and signal connections.
d. Scaled drawings showing exterior dimensions and locations of electrical and mechanical interfaces.

3. Sizing and Selection Calculations:
a. Primary Elements:
1) Complete calculations plus process data used. Example for Flow Elements:
a) Minimum and maximum values, permanent head loss, and assumptions made.

b. Controller, Computing, and Function Generating Modules: Actual scaling factors with units and how they were computed.
c. Electronic Copies: Microsoft Excel, one file for each group of components with identical sizing calculations.

4. Preliminary Panel Elevation Drawings:
a. See Section 40 67 00, Control System Equipment Panels and Racks.

5. Panel Construction Drawings:
a. See Section 40 67 00, Control System Equipment Panels and Racks.

6. Panel Wiring Diagrams:
a. See Section 40 67 00, Control System Equipment Panels and Racks.

7. Loop Wiring Diagrams: Individual, end-to-end wiring diagram for each analog and discrete or equipment loop.
a. Conform to the minimum requirements of ISA S5.4.
b. Under Paragraph 5.3 of ISA S5.4, include the information listed under Subparagraphs 2 and 6.
c. Show loop components within a panel and identify each component, component terminals, and panel terminals.

d. If a loop connects to panels or devices not provided under this section and its subsections, such as control valves, motor control centers, package system panels, variable speed drives, include the following information:
   1) Show the first component connected to within the panel or device that is not provided under this section and its subsections.
   2) Identify the component by tag and description.
   3) Identify panel and component terminal numbers.
e. Drawing Size: Individual 11-inch by 17-inch sheet for each loop.
f. Divide each loop diagram into areas for panel face, back-of-panel, field and DCS.
g. One Drawing Per Loop: Show each loop individually. No "typical" loop diagrams will be allowed.
h. Show:
   1) Terminal numbers, location of dc power supply, and location of common dropping resistors.
   2) Switching contacts in analog loops and output contacts of analog devices. Reference specific control diagrams where functions of these contacts are shown.
   3) Tabular summary on each analog loop diagram:
      a) Transmitting Instruments: Output capability.
      b) Receiving Instruments: Input impedance.
      c) Loop Wiring Impedance: Estimate based on wire sizes and lengths shown.
      d) Total loop impedance.
      e) Reserve output capacity.
   4) Circuit and raceway schedule names.
i. For each DCS input/output, include the following information:
   1) PCM number and physical location.
   2) Controller number.
   3) Type of input.
   4) I/O card location and address.
   5) All DCS-dependent displayed functions using ISA symbology.
   6) Drawing reference for DCS software content.

8. Panel Plumbing Diagrams: For each panel containing piping and tubing. Show type and size for:
   a. Pipes and Tubes: Thickness, pressure rating, and materials.
   b. Components: Valves, regulators, and filters.
   c. Connections to panel-mounted devices.
   d. Panel interface connections.
   e. Submit electronic copies of Drawings.
9. Installation Details: Include modifications or further details required and define installation of I&C components.
10. Spares, expendables, and test equipment.

11. Electronic Copies: Microsoft Excel.
12. Color schedule for control panels.
13. Test Procedures:
    a. The CONTRACTOR shall prepare written test procedures for submittal to the Owner, for approval.
        1) For each test, the procedure form should clearly define the following:
            a) Test Number.
            b) Purpose of the test: Describe what is being verified by this particular test.
            c) Test Method: Describe the setup for the test and the steps required to complete the test.
            d) Criteria: Describe the criteria for passing or failing the test.
            e) For each step, provide space on the form for the Owner or Owner's representative's comments and sign-off.
            f) Test on a loop by loop basis:
                (1) Each loop to be signed off individually.
            g) Provide a test schedule.
            h) Provide a list of all test equipment to be available for the tests.
            i) Provide a block diagram showing the test setup arrangement.
                (1) The diagram shall show the equipment under test, any special test equipment and indicate equipment interconnections including valving.
    b. Test procedures shall be submitted first prior to testing for approval.
        1) Contractor shall complete all necessary changes prior to approval.
    c. Signed test procedures shall be submitted a second time after testing is completed.
    d. Test submittal schedule:
        1) CAT and SAT Test Forms – Unsigned: Minimum 60 days before expected initiation of tests.
        2) CAT Test Forms – Signed: After CAT testing is completed and fully signed off by Owner/Engineer.
        3) SAT Test Forms – Signed: After CAT testing is completed and fully signed off by Owner/Engineer.

C. Informational Submittals:

1. Statements of Qualification:
    a. PIC System Integrator.
    b. PIC System Integrator's site representative.

c. Resume for each PIC System Integrator's onsite startup and testing team member (engineers, technicians, and software/configuring personnel).

2. Operation and Maintenance Data: In accordance with the Greenbook, the Whitebook, Section 01 33 04 – Operations and Maintenance Manuals, and in addition the following:
   a. General:
      1) Provide sufficient detail to allow operation, removal, installation, adjustment, calibration, maintenance and purchasing replacements for PIC components.
      2) Submittal Format: Both hard copy and electronic copies for all submittals. Refer to Article Submittals, heading Submittal Format.
   b. Final versions of Legend and Abbreviation Lists.
   c. Process and Instrumentation Diagrams: Marked up copy of revised P&ID to reflect as-built PIC design.
   d. Provide the following items as defined under heading Action Submittals:
      1) Bill of materials.
      2) Catalog cuts.
      3) Instrument list.
      4) Component data sheets.
      5) Detailed Wiring Diagrams:
         a) As-built drawings.
         b) Panel wiring diagrams.
         c) Loop diagrams.
         d) Interconnecting wiring diagrams.
      6) Panel plumbing diagrams.
      7) Applications software documentation.
   e. Manufacturer's O&M manuals for components, electrical devices, and mechanical devices:
      1) Content for Each O&M Manual:
         a) Table of Contents.
         b) Operations procedures.
         c) Installation requirements and procedures.
         d) Maintenance requirements and procedures.
         e) Troubleshooting procedures.
         f) Calibration procedures.
         g) Internal schematic and wiring diagrams.
         h) Component and I/O Module Calibration Sheets from field quality control calibrations.
      2) Provide PDF file will linked index to all manuals.
         a) List of spares, expendables, test equipment and tools provided.

b) List of additional recommended spares, expendables, test equipment, and tools. Include quantities, unit prices, and total costs.

3. Provide Manufacturer's Certificate of Proper Installation where specified.
4. Testing Related Submittals:
   a. Factory Demonstration Test:
      1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
      2) Final Test Procedures:
         a) Proposed test procedures, forms, and checklists.
         b) Capacity, Timing, and Simulation: Describe simulation and monitoring methods used to demonstrate compliance with capacity and timing requirements.
      3) Test Documentation: Copy of signed off test results.
   b. Functional Test:
      1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
      2) Final Test Procedures: Proposed test procedures, forms, and checklists.
      3) Test Documentation:
         a) Copy of signed-off test results.
         b) Completed component calibration sheets.
   c. Performance Test:
      1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
      2) Final Test Procedures: Proposed test procedures, forms, and checklists.
      3) Test Documentation: Copy of signed-off test results.
5. Owner Training Plan: In accordance with the Greenbook,the Whitebook, and Section 01 79 23 – Instruction of Operations and Maintenance Personnel.
6. Maintenance Service Agreement: Prior to Substantial Completion, submit service agreements signed by Owner and maintenance provider for work required under Article Maintenance Service.

1.06 QUALITY ASSURANCE

A. PIC Coordination Meetings:

1. PIC Schedule Coordination Meeting:
   a. Timing: Following Engineer review of PIC Schedule.
   b. Purpose: Discuss Engineer's comments and resolve scheduling issues.

2. Training Coordination Meeting:
    a. Timing: Following Engineer review of preliminary training plan.
    b. Purpose:
        1) Resolve required changes to proposed training plan.
        2) Identify specific Owner personnel to attend training.

1.07 DELIVERY, STORAGE, AND HANDLING

A. In accordance with the Greenbook and the Whitebook.

B. Prior to shipment, include corrosive inhibitive vapor capsules in shipping containers, and related equipment as recommended by capsule manufacturer.

C. Prior to installation, store items in dry indoor locations. Provide heating in storage areas for items subject to corrosion under damp conditions.

D. Cover panels and other elements that are exposed to dusty construction environments.

1.08 SEQUENCING AND SCHEDULING

A. Prerequisite Activities and Lead Times: Do not start following key Project activities until prerequisite activities and lead times listed below have been completed and satisfied:

1. Shop Drawing Reviews by Engineer:
    a. Prerequisite: Engineer acceptance of Schedule of Values and Progress Schedule.
    b. Schedule: In accordance with completed schedule of Shop Drawing and Sample submittals specified in the Greenbook and the Whitebook.
2. Test Prerequisite: Associated test procedures Submittals completed.
3. Training Prerequisite: Associated training plan Submittal completed.
4. Equipment Delivered to Staging Site: Refer to PIC subsections for a definition of this equipment.
    a. Prerequisites:
        1) FDT completed.
5. Software Acceptance Test Prerequisite: Component Acceptance Test completed.
6. Performance Test Prerequisite: Software Acceptance Test completed and facility started up.

1.09 MAINTENANCE

A. Maintenance Service Agreement:

1. Duration of 2 years, unless otherwise noted in PIC subsections.

2. Start on date of Substantial Completion.
3. Performed by factory-trained service engineers with experience on PIC systems to be maintained.
4. PIC Systems Covered: PIC components, except for Engineer provided applications software.
5. Materials and labor for preventive maintenance and monthly Site visits.
6. Materials and labor for demand maintenance with coverage 24 hours per day, 7 days per week.
7. Response Time: Service engineer shall be onsite within 8 hours of request by Owner.
8. Spare Parts: If not stocked onsite, delivered to Site within 24 hours from time of request.
9. Repair or replace components or software found to be faulty.
10. Replace and restock within 1 month onsite spare parts and expendables used for maintenance. Provide list of items used and replaced.
11. Submit records of inspection, maintenance, calibration, repair, and replacement within 2 weeks after each Site visit.

B. Telephone Support: As specified in PIC subsections.

C. Software Subscription: As specified in PIC subsections.

1.10 EXTRA MATERIALS

A. As specified in PIC subsections.

B. In computing spare parts quantities based on specified percentages, round up to nearest whole number.

C. Spare Parts:

Description	Percent of Each Type and Size Used	No Less Than
Annunciator light bulbs	20	**10**
Annunciator window module	10	**5**
DC power supplies	20	**2**
Fuses	20	**5**
Indicating light bulb	20	**10**
Relays	20	**3**
Terminal Blocks	10	**10**
Hand Switches and Lights	10	**5**

Description	Percent of Each Type and Size Used	No Less Than
120VAC Isolation Transformers	10	**2**
Surge Suppressors	10	**2**

D. Expendables: For following items provide manufacturer's recommended 2-year supply, unless otherwise noted.

1. Chemical for analyzers.
2. Calibration/test gas for combustible gas detection.
3. Corrosion-inhibiting vapor capsules.
4. pH sensor overhaul kits: Two.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide PIC functions shown on Drawings and required in PIC subsections for each system and loop. Furnish equipment items required in PIC subsections. Furnish materials, equipment, and software (except for Engineer provided applications software), whether indicated or not, necessary to effect required system and loop performance.

B. First Named Manufacturer: PIC design is based on first named manufacturers of equipment, materials, and software.

1. If an item is proposed from other than first named manufacturer, obtain approval from Engineer for such changes in accordance with AIA Document A201 – 2007 and AIA Document A133 – 2009.
2. If proposed item requires, but not limited to, different installation, wiring, raceway, enclosures, intrinsically safe barriers, and accessories, provide such equipment and work.

C. Like Equipment Items:

1. Use products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.
2. Implement same or similar functions in same or similar manner. For example control logic, sequence controls, and display layouts.

2.02 SERVICE CONDITIONS

A. Standard Service Conditions: The following defines certain types of environments. PIC subsections refer to these definitions by name to specify the service conditions for individual equipment units. Design equipment for continuous operation in these environments:

1. Computer Room, Air Conditioned:
   a. Temperature: 60 degrees F to 80 degrees F.
   b. Relative Humidity: 40 percent to 60 percent.
   c. NEC Classification: Nonhazardous.
2. Indoors, Air Conditioned:
   a. Temperature:
      1) Normal: 60 degrees F to 80 degrees F.
      2) With Up to 4-Hour HVAC System Interruptions: 40 degrees F to 105 degrees F.
   b. Relative Humidity:
      1) Normal: 10 percent (winter) to 70 percent (summer).
      2) With Up to 4-Hour HVAC System Interruption: 10 percent to 100 percent.
   c. NEC Classification: Nonhazardous.
3. Indoors:
   a. Temperature: **20 degrees F to 104** degrees F.
   b. Relative Humidity: **10 percent to 100 percent.**
   c. NEC Classification: Nonhazardous.
4. Indoors, Corrosive:
   a. Temperature: **Minus 20 degrees F to 104** degrees F.
   b. Relative Humidity: **10 percent to 100 percent.**
   c. Corrosive Environment: **Sea air.**
   d. NEC Classification: Nonhazardous.
5. Outdoors:
   a. Temperature: **Minus 20 degrees F to 104** degrees F.
   b. Relative Humidity: **10 percent to 100 percent and rain**.
   c. NEC Classification: Nonhazardous.

B. Standard Service Conditions for Panels and Consoles: Unless otherwise noted, in **Instrument List and** Control Panel Schedule located in Article Supplements at End of Section, design equipment for continuous operation in these environments:

1. Freestanding Panel and Consoles:
   a. Inside, Air Conditioned: NEMA 1.
   b. Inside: NEMA 12.
2. Smaller Panels and Assemblies (that are not freestanding):
   a. Inside, Air Conditioned: NEMA 12.
   b. All Other Locations: NEMA 4X.

3. Field Elements: Outside.

C. Special Environmental Requirements: Design following panels for continuous operation in environments listed.

2.03 NAMEPLATES AND TAGS

A. Panel Nameplates: Enclosure identification located on enclosure face.

1. Materials: Laminated plastic attached to panel with stainless steel screws.
2. Letters: 1/2-inch-high, white on black background, unless otherwise noted.

B. Component Nameplates, Panel Face: Component identification located on panel face under or near component.

1. Location and Inscription: As shown on panel drawing.
2. Materials: Adhesive-backed, laminated plastic.
3. Letters: 3/16-inch-high, white on black background, unless otherwise noted.

C. Component Nameplates, Back of Panel: Component identification located on or near component inside of enclosure.

1. Inscription: Component tag number.
2. Materials: Adhesive-backed, laminated plastic.
3. Letters: 3/16-inch-high, white on black background, unless otherwise noted.

D. Legend Plates for Panel Mounted Pushbuttons, Lights, and Switches.

1. Inscription:
   a. Refer to table under Paragraph Standard Pushbutton Colors and Inscriptions.
   b. Refer to table under Paragraph Standard Light Colors and Inscriptions.
   c. Refer to P&IDs on Drawings.
2. Materials: Stainless steel, keyed legend plates. Secured to panel by mounting nut for pushbutton, light, or switch.
3. Letters: Black on gray or white background.

E. Service Legends: Component identification nameplate located on face of component.

1. Inscription: As shown on panel drawing.
2. Materials: Adhesive-backed, laminated plastic.

3. Letters: 3/16-inch-high, white on black background, unless otherwise noted.

F. Nametags: Component identification for field devices.

1. Inscription: Component tag number.
2. Materials: 16-gauge, Type 304 stainless steel.
3. Letters: 3/16-inch-high, imposed.
4. Mounting: Affix to component with 16-guage or 18-gauge stainless steel wire or stainless steel screws.

2.04 ELECTRICAL REQUIREMENTS

A. Electrical Raceways: As specified in Section 26 05 33, Raceway and Boxes.

B. Wiring External to PIC Equipment:

1. Special Control and Communications Cable: Provided by PIC System Integrator as noted in Component Specifications and PIC subsections.
2. Other Wiring and Cable: As specified in Section 26 05 05, Conductors.

C. I&C and electrical components, terminals, wires, and enclosures **UL recognized or UL listed**.

D. Wires within Enclosures:

1. See Section 40 67 00, Control System Equipment Panels and Racks for additional requirements.
2. Special Signal Circuits: Use manufacturer's standard cables.
3. Wire Identification: Numbered and tagged at each termination.
   a. Wire Tags: Machine printed, heat shrink.
   b. Manufacturers:
      1) Brady Perma Sleev.
      2) Tyco Electronics.
      3) Or equal.

E. Terminate and identify wires entering or leaving enclosures as follows:

1. Analog and discrete signal, terminate at numbered terminal blocks.
2. Special signals terminated using manufacturer's standard connectors.
3. Identify wiring in accordance with requirements in Section 26 05 05, Conductors.
4. See Section 40 67 00, Control System Equipment Panels and Racks for additional requirements.

F. Grounding of Enclosures:

1. See Section 40 67 00, Control System Equipment Panels and Racks.

G. Analog Signal Isolators:

1. Furnish signal isolation for analog signals that are sent from one enclosure to another.
2. Do not wire in series instruments on different panels, cabinets, or enclosures.

H. Intrinsic Safety System Installation:

1. Comply with NEC Article 504, Intrinsically Safe Systems.
2. Install intrinsically safe circuits in a separate wire way that:
   a. Is separated from nonintrinsically safe circuits as specified by NEC.
   b. Is colored light blue and has message “Intrinsically Safe Circuits Only” on raceway cover every 6 inches.
   c. See Section 40 67 00, Control System Equipment Panels and Racks for additional requirements.

I. Wiring Interface: Terminate and identify wiring entering or leaving enclosures.

1. Analog and Discrete Signal Wires: Terminate at numbered terminal blocks as shown on the wiring diagrams.
2. Wiring for Special Signals: Terminate communications, digital data, and multiplexed signals using manufacturer’s standard connectors for the device to which the signals terminate.

2.05 TEST EQUIPMENT AND TOOLS

A. Digital Multimeter:

1. Type: Industrial True RMS Digital Multimeter, CAT IV 600V protection with test leads, removable test probes, long reach alligator clips, magnetic hanger, temperature probe, and carrying case.
2. Quantity: 2.
3. Manufacturers and Products:
   a. Fluke; Model 87V/E Industrial Electrician Combo Kit.
   b. Greenlee; Model DM-860.
   c. Extech; Model EX530.
   d. Or approved equal.

B. Clamp-on Ammeter:

1. Type: True RMS Digital Clamp-on meter with 3-1/2-digit display and protective case.
2. Quantity: 1.

3. Manufacturers and Products:
   a. TES; Model 3040.
   b. Fluke; Model 337E.
   c. Greenlee; Model CMI-100.
   d. Extech; Model EX830.
   e. Or approved equal.

C. DC Digital Process Signal Calibrator:

1. Type: Portable, two-channel, with test leads, rechargeable batteries, charger, and carrying case.
2. Quantity: 2.
3. Manufacturers and Products:
   a. Transmation; Model 1045-01.
   b. Fluke; Model 789.
   c. Extech; Model CMM17.
   d. Or approved equal.

CI. Pressure and Electrical Calibrator:

1. Type: Test leads, rechargeable batteries, ac charger, pressure transducer modules, and protective case.
2. Pressure Ranges: **Appropriate for pressure devices provided.**
3. Quantity: 1.
4. Manufacturers and Products:
   a. Transmation; Model 1091PLUS-LP.
   b. Fluke; Model 717/718.
   c. Heise; Model PTE-1.
   d. Or approved equal.

CII. Pressure Pump Kit:

1. Type: Hand pump (0 to 600 psig), calibration labels, tubing, fittings, and carrying case.
2. Quantity: 1.
3. Manufacturers and Products;
   a. Transmation; Pump Kit 22980P-300.
   b. Fluke; Model 700PTP-1.
   c. Heise; Model TP1-40.
   d. Or approved equal.

CIII. Small Tool Kit:

1. Type: Kit of instrument maintenance tools in soft, zipper case.
2. Quantity: 1.
3. Manufacturer and Product: Jensen Tools; Model JTK-47GC Field Engineer’s Kit or approved equal.

CIV. Large Tool Kit:

1. Type: Kit of instrument maintenance tools in high-density polyethylene case.
2. Quantity: 1.
3. Manufacturer and Product: Jensen Tools; Model JTK-17LST.
4. Or approved equal.

H. Terminal Kit:

1. Type: Kit of solderless terminals and cable ties.
2. Quantity: 1.
3. Manufacturer and Product: Jensen Tools; Model 23B210.
4. Or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. For equipment not provided by PIC System Integrator, but that directly interfaces with PIC, verify the following conditions:

1. Proper installation.
2. Calibration and adjustment of positioners and I/P transducers.
3. Correct control action.
4. Switch settings and dead bands.
5. Opening and closing speeds and travel stops.
6. Input and output signals.

3.02 INSTALLATION

A. Material and Equipment Installation: Follow manufacturers' installation instructions, unless otherwise indicated or directed by Engineer.

B. Wiring connected to PIC components and assemblies, including power wiring in accordance with requirements in Section 26 05 05, Conductors.

C. Electrical Raceways: As specified in Section 26 05 33, Raceway and Boxes.

D. Mechanical Systems:

1. Copper and Stainless Steel Tubing Support: Continuously supported by aluminum tubing raceway system.
2. Plastic Tubing Support: Except as shown on Drawings, provide continuous support in conduit or by aluminum tubing raceway system.
3. Install conduit for plastic tubing and tubing raceways parallel with, or at right angles to, structural members of buildings. Make vertical runs straight and plumb.
4. Tubing and Conduit Bends:
   a. Tool-formed without flattening, and of same radius.

b. Bend Radius: Equal to or larger than conduit and tubing manufacturer's recommended minimum bend radius.
c. Slope instrument connection tubing in accordance with installation details.
d. Do not run liquid filled instrument tubing immediately over or within a 3-foot plan view clearance of electrical panels, motor starters, or mechanical mounting panel without additional protection. Where tubing must be located in these zones, shield electrical device to prevent water access to electrical equipment.
e. Straighten coiled tubing by unrolling on flat surface. Do not pull to straighten.
f. Cut tubing square with sharp tubing cutter. Deburr cuts and remove chips. Do not gouge or scratch surface of tubing.
g. Blow debris from inside of tubing.
h. Make up and install fittings in accordance with manufacturer's recommendations. Verify make up of tube fittings with manufacturer's inspection gauge.
i. Use lubricating compound or TFE tape on stainless steel threads to prevent seizing or galling.
j. Run tubing to allow but not limited to, clear access to doors, controls and control panels; and to allow for easy removal of equipment.
k. Provide separate support for components in tubing runs.
l. Supply expansion loops and use adapters at pipe, valve, or component connections for proper orientation of fitting.
m. Keep tubing and conduit runs at least 12 inches from hot pipes.
n. Locate and install tubing raceways in accordance with manufacturer's recommendations. Locate tubing to prevent spillage, overflow, or dirt from above.
o. Securely attach tubing raceways to building structural members.

5. Enclosure Lifting Rings: Remove rings following installation and plug holes.

3.03 FIELD QUALITY CONTROL

A. General:

1. Coordinate PIC testing with Owner and affected Subcontractors.
2. Notify Engineer of Performance Test schedule 4 weeks prior to start of test.
3. Engineer may actively participate in tests.
4. Engineer reserves right to test or retest specified functions.
5. Engineer's decision will be final regarding acceptability and completeness of testing.

B. Onsite Supervision:

1. Require PIC System Integrator to observe PIC equipment installation to extent required in order to provide Certificates of Proper Installation.
2. Require PIC site representative to supervise and coordinate onsite PIC activities.
3. Require PIC site representative to be onsite while onsite work covered by this section and PIC subsystems is in progress.

C. Testing Sequence:

1. Completion: When tests have been completed and required test documentation has been accepted.
    a. The completion of the Component Acceptance Test (CAT) is a pre-requisite for the Site Acceptance Test (SAT).

3.04 TESTING

A. Prior to Facility Startup and Performance Evaluation period for each facility, inspect, test, and document that associated PIC equipment is ready for operation.

B. Testing will be deemed complete if there are no failures during the test.

1. Should the system under test fail, the cause of the failure shall be identified and rectified by the CONTRACTOR and the entire test shall be restarted from the beginning.
2. The CONTRACTOR shall document any failures and the corrective action required to restore the system to proper operation.
3. The CONTRACTOR shall provide a copy of the documentation to the Owner within 24 HRS of the failure, or notification of a failure.
4. A failure is defined as the inability of any component to perform its intended function, regardless of the cause or severity of the failure.
    a. The CONTRACTOR shall not be responsible for correction of software configuration failures/other failures outside his scope of work.
5. If a failure occurs, the test shall be stopped immediately and demonstration testing will reconvene after a minimum of 7 days or at the discretion of the Owner.

C. Component Acceptance Test (CAT): Test conducted by the PIC System Integrator to check for proper installation and calibration and to verify each component on a loop-by-loop basis.

1. Calibration:
    a. After installation but before starting the remaining tests, calibrate and adjust all instruments, devices, valves, and system, in conformance with the component manufacturer's instructions and in accordance with these Specifications.

b. Components having adjustable features are to be set carefully for the specific conditions and applications of this installation. Test and verify that components and/or systems are within the specified limits of accuracy.
c. Replace either individually or within a system, defective elements that cannot achieve proper calibration or accuracy.
d. Calibration Points: Calibrate each analog instrument at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of span, using test instruments with accuracies traceable to National Institute of Testing Standards.
e. Field verify calibration of instruments that have been factory calibrated to determine whether any of the calibrations are in need of adjustment.
f. Analyzer Calibration: Calibrate and test each analyzer system as a workable system after installation. Follow the testing procedures directed by the manufacturers' technical representatives.

2. Complete instrument calibration sheets for every field instrument and analyzer.
3. Calibration Tags:
   a. Attach a calibration and testing tag to each instrument, piece of equipment, or system.
   b. Sign the tag when calibration is complete.
4. Check all control loops under simulated operating conditions by causing a range of input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the SCADA System. Issue commands from the SCADA System and verify proper responses of field devices. Use actual process inputs wherever available.
5. Provide “End-to-End” Tests:
   a. Test SCADA system inputs from field device to SCADA System operator workstations.
   b. Test SCADA System outputs from SCADA operator workstations to field devices and equipment.
   c. Observe and record responses at all intermediate devices.
   d. Test and record operator commands and signal readouts to each operator device where there is more than one operator interface point.
   e. For each signal, perform separate tests for SCADA computer screens, local operator interface (LOI) screens, and local control panels.
6. Retest any loop following any necessary corrections.
7. Apply simulated sensor inputs corresponding to 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of span for networks that incorporate analog elements, and monitor the resulting outputs to verify compliance to accuracy tolerance requirements.

8. Apply continuously variable up and down analog inputs to verify the proper operation and setting of discrete devices (signal trips, etc.).
9. Apply provisional settings on controllers and alarm set points.
10. Record all analog loop test data on test forms.
11. Exercise each field device requiring an analog command signal, through the SCADA System. Vary, during the validation process, the output from the PLC SCADA System and measure the end device position, speed, etc., to confirm the proper operation of the device for the supplied analog signal. Manually set the output from the SCADA screen at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent and measure the response at the final device and at any intermediate devices.
12. Exercise each field device providing a discrete input to the SCADA System in the field and observe the proper operation shall be observed at the operator workstation:
    a. Test limit switches, set limits mechanically, and observe proper operation at the operator workstation.
    b. Exercise starters, relay contacts, switch contacts, and observe proper operation.
    c. Calibrate and test instruments supplying discrete inputs, and observe proper operation.
13. Test each device accepting a discrete output signal from the SCADA. Perform the appropriate operator action at the SCADA operator stations (including LOIs, if present) and confirm the proper operation of the field device:
    a. Stroke valves through outputs from the SCADA System, and confirm proper directional operation. Confirm travel limits and any feedback signals to the SCADA System.
    b. Exercise motors starters from the SCADA System and verify proper operation through direct field observation.
    c. Exercise solenoids and other field devices from the SCADA System and verify proper operation through direct field observation.
14. Include in the Test Forms:
    a. Analog Input Devices:
        1) Calibration range.
        2) Calibration Data: Input, output, and error at each test value.
        3) Analog input associated PLC register address.
        4) Value in PLC register at each test point.
        5) Value displayed at each operator interface station (local operator interface displays and SCADA workstations).
    b. Analog Output Devices:
        1) Calibration range.
        2) Test value at each test point.
        3) Analog output associated PLC register address.
        4) Control variable value at field device at each test point.
        5) Physical device response at each test point:

6) Response to be actual valve position, or motor speed, etc.

c. Discrete Instrument Input Devices:
   1) Switch setting, contact action, and dead band.
   2) Valve Position Switches:
      a) Response in the PLC as the valve is stroked from the PLC.
      b) Field observed actual valve position, and valve indicator position as the valve is stroked from the PLC.
   3) Operator interface switches (control stations and other pilot devices) and associated response.
   4) Starter and drive auxiliary device contact response.
   5) Response of all other discrete inputs to the PLC.

d. Discrete Output Devices:
   1) Observed response of field device to the discrete output from the PLC.
   2) Observe the proper operation of Open, Close, Start, Stop, On, Off, etc.

e. Test equipment used and associated serial numbers.

D. Site Acceptance Test (SAT): Tests conducted by the Engineer, with the assistance of the PIC System Integrator, similar to Factory Software Acceptance Test (FSAT), except that the entire installed system shall be tested and all functions demonstrated using live field-based data to the greatest extent possible.

1. General:
   a. Commence Precommissioning Tests after completion of all loop check/validation tests (CAT):
      1) Precommissioning to demonstrate proper operation of all systems with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.
      2) Follow accepted detailed test procedures and check lists for all precommissioning and test activities.
   b. SAT cannot begin until CAT has been completed in full and test form submittal has been approved by Owner/Engineer.
2. Control Logic Operational Validation:
   a. The purpose of Control Logic Validation is to field test the operation of the complete control system, including all parts of the SCADA System, all control panels (including vendor control panels), all control circuits, all control stations, all monitored/controlled equipment, and final control elements.
   b. Demonstrate all control functionality shown on the P&IDs, Control Schematics, and other Drawings, and specified in the

Loop Descriptions, Control Strategies, Electrical Specifications, and Mechanical Equipment Specifications.

c. Test in detail on a function-by-function and sentence-by-sentence basis.

3. Thoroughly test all hardware and software functions:
4. Including all hardwired and software control circuit interlocks and alarms.
   a. Test final control elements, controlled equipment, control panels, and ancillary equipment under startup, shutdown, and steady-state operating conditions to verify all logic and control is achieved.
   b. Control Logic Validation tests to include, but not limited to, a repeat of all control logic tests from the FSAT, modified and expanded to include all field instruments, control panels, circuits, and equipment.
5. Loop Tuning:
   a. Optimally tune all electronic control stations and software control logic incorporating proportional, integral, or derivative control. Apply control signal disturbances at various process variable levels and adjusting the gain, reset, or rate settings as required to achieve proper response.
   b. Verify the transient stability of final control elements operating over the full range of operating conditions, by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates. As a minimum, achieve 1/4 wave amplitude decay ratio damping (subsidence ratio of 4) under the full range of operating conditions.
6. Precommissioning Validation Sheets:
   a. Document each Precommissioning Test on an accepted test form.
   b. Document loop tuning with a report for each loop, including two-pen chart recordings showing the responses to step disturbance at a minimum of three setpoints or process rates accepted Owner. Show tuning parameters on the charts, along with time, date, and sign-off by the Owner.
7. Include on the form, functions which can be demonstrated on a loop-by-loop basis:
   a. Loop number and P&ID number.
   b. Control strategy, or reference to specification tested.
   c. Test Procedures: Where applicable, use the FAT function-by-function, sentence-by-sentence Loop Test Checklist forms modified to meet the requirements of the Precommissioning Test. Otherwise, create new forms.
8. For functions that cannot be demonstrated on a loop-by-loop basis (such as overall plant power failure), include on the test form a listing of the

specific steps and tests to be conducted. Include with each test description the following information:
a. Specification page and paragraph of function demonstrated.
b. Description of function and/or text from specification.
c. Test Procedures: Use the FAT Loop Test Checklist forms modified to meet the specific testing conditions of the Precommissioning Test.

9. SAT Certification:
a. Document via a certified report the completion of all SAT test activities:
1) Including all test forms with test data entered, submitted to the Owner with a clear and unequivocal statement that all precommissioning test requirements have been satisfied.

3.05 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: As required by each PIC subsection.

B. Specialty Equipment: For certain components or systems provided under this section, but not manufactured by PIC System Integrator, provide services of qualified manufacturer's representative during installation, startup, demonstration testing, and training.

3.06 TRAINING

A. General:

1. Provide an integrated training program for Owner's personnel.
2. Perform training to meet specific needs of Owner's personnel.
3. Include training sessions, classroom and field, for managers, engineers, operators, and maintenance personnel.
4. Provide instruction on **two** working shift(s) as needed to accommodate the Owner's personnel schedule.
5. Owner reserves the right to reuse videotapes of training sessions.
6. See the Greenbook, the Whitebook, and Section 01 79 23 – Instruction of Operations and Maintenance Personnel for additional details.

B. Operations and Maintenance Training:

1. General:
a. Refer to specific requirements specified in PIC Subsections.
b. Include review of O&M data and survey of spares, expendables, and test equipment.
c. Use equipment similar to that provided.
d. Unless otherwise specified in PIC subsections, provide training suitable for instrument technicians with at least a 2-year associate

engineering or technical degree, or equivalent education and experience in electronics, instrumentation, or digital systems.

e. See the Greenbook, the Whitebook, and Section 01 79 23 – Instruction of Operations and Maintenance Personnel for additional details.

2. Operations Training: For Owner's operations personnel on operation of I&C components.
   a. Training Session Duration: **1** instructor day.
   b. Number of Training Sessions: **Two.**
   c. Location: Project Site.
   d. Course Objective: Develop skills needed to use I&C components and functions to monitor and control the plant on a day-to-day basis.
   e. Content: Conduct training on loop-by-loop basis.
      1) Loop Functions: Understanding of loop functions, including interlocks for each loop.
      2) Loop Operation: For example, adjusting process variable setpoints, AUTO/MANUAL control transfer, AUTO and MANUAL control, annunciator acknowledgement and resetting.
      3) Interfaces with PIC subsystems.
3. Maintenance Training:
   a. Training Session Duration: **A: 1** instructor day.
   b. Number of Training Sessions: **Two.**
   c. Location: Project Site.
   d. Course Objective: Develop skills needed for routine maintenance of PIC.
   e. Content: Provide training for each type of component and function provided.
      1) Loop Functions: Understanding details of each loop and how they function.
      2) Component calibration.
      3) Adjustments: For example, controller tuning constants, current switch trip points, and similar items.
      4) Troubleshooting and diagnosis for equipment and software.
      5) Replacing lamps, chart paper, and fuses.
      6) I&C components removal and replacement.
      7) Periodic preventive maintenance.

3.07 CLEANING

A. Upon completion of Work, remove materials, scraps, and debris from interior and exterior of equipment.

3.08 PROTECTION

A. Use corrosion-inhibiting vapor capsules in enclosures to protect electrical, instrumentation, and control devices, including spare parts, from corrosion.

B. Periodically replace capsules based on capsule manufacturer's recommendations.

END OF SECTION

SECTION 40 90 04
REFERENCES

PART 1– GENERAL

1.1 GENERAL:

A. Where the requirements set forth in the Contract Documents are greater or more rigid than the mandatory requirements referenced herein the applicable portions of the Contract Documents shall govern.

B. In the case of conflict between any mandatory requirements and the Contract Documents, the mandatory requirement shall be followed in each case, but only after submitting such proposed changes to the City's representative for approval.

C. Nothing contained in the Contract Documents shall be so construed to conflict with any national state, municipal, or local laws or regulations governing the installation of Work specified herein, and all such acts, ordinance, and regulations, including the National Electrical Code, are hereby incorporated and made a part of the Contract Documents. All such requirements shall be satisfied by the DCSP at no additional expense to the City.

1.2 PERMITS:

A. Construction permits are the responsibility of the Contractor. However, The DCSP shall be responsible for obtaining any Plant permits, 'outage requests' etc. imposed by the City and Plant standard operating procedure.

1.3 REFERENCES:

A. The equipment materials, installation, and other work shall conform to all the following applicable regulations, standards, specifications, and codes unless a more current version is applicable:

1. American National Standards Institute (ANSI):
   a. ANSI INCITS 154 (2004), Office Machines and Supplies Alphanumeric Machines - Keyboard Arrangement.
   b. ANSI ISO/IEC 17799 (2005), Information Technology Security Techniques Code of Practice for Information Security Management.
   c. ANSI C80.1 (2005), Standard for Rigid Steel Electrical Conduit

2. ASTM International (ASTM):
   a. ASTM D 709 (2007), Standard Specification for Laminated Thermosetting Materials (Nameplates).
   b. ASTM E 814 (2006), Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
   c. ASTM F 512 (2006), Standard Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation.
3. American Society for Quality (ASQ): ASQ C1, Specification of General Requirements for a Quality Plan.
4. California State Codes:
   a. California State Administrative Code, Title 24, State Building Standard.
   b. (CAL/OSHA) California State Occupational Safety and Health Act.
   c. California State Fire Marshal Standards.
5. City of San Diego:
   a. Green Book, City of San Diego Standard Plans and Specifications.
   b. City of San Diego Municipal Code.
   c. City of San Diego Electrical Code as adopted from NEC.
   d. Latest City of San Diego Electrical, Fire and Building Codes and U.B.C. Supplement.
6. IEC/EN Standards Institution:
   a. EN 55022: 1998, based on CISPR 22, is used in the EU and worldwide for measuring radiated and line conducted emissions from ITE (Information Technology Equipment).
   b. BS EN 55011 (2007), Industrial, Scientific, and Medical (ISM) Radio-Frequency Equipment – Electromagnetic Disturbance Characteristics - Limits and Methods of Measurement.
   c. IEC 61000-4-2 (2001), Electrostatic Discharge Immunity Test, supersedes/replaces IEC 801-2
   d. BS EN 61000-4-3 (2006), Electromagnetic Compatibility (EMC) Part 4-3: Testing and Measurement Techniques – Radiated, Radio-Frequency, Electromagnetic Field Immunity Test, supersedes/replaces IEC 801-3.
   e. IEC 61000-4-4 (2004), Electrical Fast Transient/Burst Immunity Test, supersedes/replaces IEC 801-4.
   f. IEC 61000-4-5 (2005), Surge Immunity Test, supersedes/replaces IEC 801-5.
   g. BS EN 61000-4-6 (2007), Electromagnetic Compatibility (EMC) Part 4-6: Testing and Measurement Techniques - Immunity to Conducted Disturbances, Induced by Radio Frequency Fields, supersedes/replaces IEC 801-6.
   h. BS EN 61000-4-11 (2004), Electromagnetic Compatibility (EMC) Part 4-11: Testing and Measurement Techniques - Voltage Dips, Short Interruptions, and Voltage Variations Immunity Tests.

i. EN 61000-6-4:2007, Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments.

7. International Electrotechnical Commission (IEC):
   a. IEC 60068-2-6 (1995), Swept Vibration.
   b. IEC 60068-2-27 (2004), Shock.
   c. IEC 60068-2-34, Random Vibration.
   d. IEC 61158, Foundation Fieldbus.
   e. IEC 61131-3 (2003), Deals with programming languages and defines three graphical and two textual PLC programming language standards.
   f. IEC 61131-8 (2003), Guidelines for the Application and Implementation of Programming Languages.
   g. IEC 61499 (2005), Function Block Standard.
8. Institute of Electrical and Electronics Engineers (IEEE)
   a. IEEE C2 (2007), National Electrical Safety Code.
   b. IEEE C37.90.1 (1989 R 2002), Standard for SWC Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
   c. IEEE C57.13 (1993; R 2003), Standard Requirements for Instrument Transformers.
   d. IEEE C62.41.2 (2002), Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
   e. IEEE 81 (1983), Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
   f. IEEE 100 (2000), The Authoritative Dictionary of IEEE Standards Terms.
   g. IEEE 315 (1995; R 2002), Graphic Symbols for Electrical and Electronics Diagrams.
   h. IEEE 484 (2002), Recommended Practice for Installation Design and Implementation of Vented Lead-acid Batteries for Stationary Applications.
   i. IEEE 485 (1997; R 2003), Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications.
   j. IEEE 754, Standard for Floating Point Arithmetic
   k. IEEE 802.1AB - Station and Media Access Control Connectivity Discovery.
   l. IEEE 802.1D (2004), Media Access Control Bridges.
   m. IEEE 802.2 (1998; R 2003), Standards for Local Area Networks: Logical Link Control.
   n. IEEE 802.3 (2005), Carrier Sense Multiple Access with Collision Detection (CSMA/CD) (Ethernet).
   o. IEEE 802.3z, Gigabit/s Ethernet Operation.
   p. IEEE 802.3ae, 10 Gigabit/s Ethernet Operation.
   q. IEEE 802.3af, Data Terminal Equipment (DTE) Power via MDI.

r. IEEE 802.1p, Traffic Classification/Prioritization.
s. IEEE 802.1q, Virtual Local Area Networks (LANs).
t. IEEE 802.1x, Comprehensive security framework.
u. IEEE 1100 (2005), Recommended Practice for Powering and Grounding Electronic Equipment.

9. Instrumentation, Systems, and Automation Society (ISA):
   a. ISA S5.1 (1984; R 1992), Instrumentation Symbols and Identification.
   b. ISA S5.2 (1976; R 1992), Binary Logic Diagrams for Process Operations.
   c. ISA S5.4 (1991), most enhanced, Instrument Loop Diagrams.
   d. ISA S5.5 (1985), Graphic Symbols for Process Displays.
   e. ISA 77.20 (1993; R 2005), Fossil Fuel Power Plant Simulators – Functional Requirements.
   f. ISA TR 99.00.01 (2004), Security Technologies for Manufacturing and Control Systems.
   g. ISA TR 99.00.02 (2004), Integrating Electronic Security into the Manufacturing and Control Systems.
10. The Internet Engineering Task Force (IETF):
   a. RFC 1112 (1989), Host Extensions for Internet Protocol (IP) Multicasting.
   b. RFC 768 (1980), User Datagram Protocol (UDP).
   c. RFC 791 (1981), Internet Protocol (IP).
   d. RFC 792 (1981), Internet Control Message Protocol (ICMP).
   e. RFC 793 (1981), Transmission Control Protocol (TCP).
   f. RFC 826 (1982), Ethernet Address Resolution Protocol (ARP).
   g. RFCs 1155, 1157, and 1212, The SNMPv1 NMF
   h. RFCs 1441 through 1452 SNMPv2 NMF.
   i. RFC 1812 (1995), Requirements for IP Version 4 Routers.
   j. RFC 1918 (1996), Address Allocation for Private Internets.
   k. RFC 2131 (1997), Dynamic Host Configuration Protocol (DHCP).
   l. RFC 2784 (2000), Generic Routing Encapsulation (GRE).
   m. RFC 2821 (2001), Simple Mail Transfer Protocol (SMTP).
11. International Organization for Standardization (ISO)
   a. ISO OSI Model, Open Systems Interconnection Reference Model.
   b. ISO/IEC 9899 (1999; R 2005), Programming Languages: C.
   c. ISO 11064-1:2000, Ergonomic design of control centers -- Part 1: Principles for the design of control centers, Part 2: Principles for the arrangement of control suites, Part 3: Control room layout, Part 4: Layout and dimensions of workstations, Part 6: Environmental requirements for control centers.
   d. ISO/IEC 11801 (2002), Information Technology – General Cabling for Customer Premises.
   e. ISO 15408-1 (2005), Security Techniques – Evaluation Criteria for IT Security.

f. ISO/IEC 15802-3 (1998), Information Technology – Telecommunications and Information Exchange between Systems – Media Access Control (MAC) Bridges.
g. ISO 60300 (2004), Dependability Management.
h. ISO 60409 (1981), Guide for the Inclusion of Reliability Clauses into Specifications for Components (or Parts) for Electronic Equipment.
i. ISO 60605 (2001), Equipment Reliability Testing.
j. ISO 60706 (2006), Maintainability of Equipment.

12. International Telecommunication Union:
    a. ITU-T G.652C & D Characteristics of single-mode optical fiber and cable.
13. Military Standards:
    a. Military Standard 810E, Laptop Shock/Vibration and drop requirements.
14. National Electrical Manufacturers Association (NEMA):
    a. NEMA 250 (2003), Enclosures for Electrical Equipment (1000 Volts Maximum).
    b. NEMA ICS 1 (2000; R 2005), Standards for Industrial Control and Systems: General Requirements.
    c. NEMA ICS 2 (2000; R 2005), Standards for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment.
    d. NEMA ICS 4 (2005), Standards for Industrial Control and Systems: Terminal Blocks.
    e. NEMA ICS 6 (2006), Standards for Industrial Control and Systems Enclosures.
    f. NEMA WD 1 (1999; R 2005), General Color Requirements for Wiring Devices.
    g. NEMA WD 6 (2002), Wiring Devices – Dimensional Requirements.
    h. NEMA PE 1 (2003; R 2003), Uninterruptible Power Systems – Specification and Performance Verification.
    i. NEMA TC 2 (2003), Electrical Polyvinyl Chloride (PVC) Conduit.

15. National Fire Protection Association (NFPA) – All applicable sections including, but not limited to: NFPA 70 (2005), National Electrical Code.
    a. NFPA 72 (2006), National Fire Alarm Code.
    b. NFPA 70E (2015), Standard for Electrical Safety in the workplace
    c. NFPA 101 (2005), Life Safety Code.
    d. NFPA 110 (2005), Standard for Emergency and Standby Power Systems.
    e. NFPA 262 (2006), Test for Flame Travel and Smoke of Wires and Cables for Use in Air--handling Spaces.
    f. NFPA 820 (2007), Standard for Fire Protection in Wastewater

Treatment and Collection Facilities.

16. National Institute Standards Technology (NIST):
    a. System Protection Profile, (2004), Industrial Control Systems, Version 1.0. Decisive Analytics. NIST.
    b. NIST SP 800-12 (1995), An Introduction to Computer Security: The NIST Handbook.
    c. NIST SP 800-14 (1996), Generally Accepted Principles and Practices for Securing Information Technology Systems.
    d. NIST SP 800-82-A (2004), Engineering Principles for Information Technology Security (A Baseline for Achieving Security).
17. Scientific Apparatus Makers Association (SAMA):
    a. SAMA have taken their standards out of circulation and declared that they are out of date.
        1) SAMA PMC 32.1 1976, A Guide for Process Measurement and Control Instrumentation Reliability Techniques is for reference only and can be obtained at www.measure.org, and was re-published in 1981.
        2) SAMA PMC 33.1 replaced by FCC and EN standards.
18. Telecommunications Industry Association (TIA):
    a. TIA-455-13-A (1996; R 2002), FOTP-13 Visual and Mechanical Inspection of Fiber Optic Components, Devices, and Assemblies.
    b. ANSI/TIA-455-78-B (2002), Optical Fibers Part 1-40: Measurement Methods and Text Procedures – Attenuation.
    c. TIA-455-133-A (2003), Optical Fibers - Part 1-22: Measurement Methods and Test Procedures - Length Measurement.
    d. TIA/EIA-568-B.1 (2001 Addendums 2001, 2003, 2003, 2003, 2004, 2007), Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements.
    e. TIA/EIA-568-B.2 (2002), Commercial Building Telecommunications Cabling Standard.
    f. TIA/EIA-568-B.3 (2000), Optical Fiber Cabling Components Standard.
    g. TIA/EIA-606-A (2002), Administration Standard for the Telecommunications Infrastructure.
    h. TIA J-STD-607-A (2002), Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
19. U.S. Department of Defense (DOD), MIL-STD-2202A (1994), Energy Monitoring and Control Systems, Factory Tests.
20. U.S. Federal Communications Commission (FCC), FCC 47 CFR Part 15 (2006), Radio Frequency Devices Electromagnetic Compliance Requirements.

21. Underwriters Laboratories (UL)
    a. UL 6 (2004), Standard for Safety Electrical Rigid Metal Conduit Steel.
    b. UL 44 (2005), Standard for Safety Thermoset-Insulated Wires and Cables.
    c. UL 467 (2007), Standard for Grounding and Bonding Equipment. PlantUL 651 (2005), Standard for Safety Schedule 40 and 80 Rigid PVC Conduit and Fittings.
    d. UL 916 (1998; Revised through March 2006), Energy Management Equipment.
    e. UL 1479 (2003), Fire Tests of Through-Penetration Firestops.
    f. UL 1778 (2005), Uninterruptible Power Systems.
    g. UL 60950 (2000), Safety of Information Technology Equipment.
22. Web Service Standards:
    a. WS-Policy.
    b. WS-Security.
    c. WS-Reliable Messaging.
    d. WS-Addressing.
    e. WSDL1.1.
    f. SOAP 1.1.
23. Uniform Fire Code (UFC):
24. Occupational Safety and Health Act (OSHA)
25. Department of Homeland Security: “Cyber Security Procurement Language for Control Systems”, August 2008.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END SECTION

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SECTION 40 90 05
DEFINITIONS

PART 1 – GENERAL

1.1 DEFINITIONS

A. Terms used in this section:

1. ACAD: AutoCAD
2. AP: Access Point. A wireless access point (WAP or AP) is a device that "connects" wireless communication devices together to create a wireless network.
3. API: Application Programming Interface are a set of definitions of the ways in which 1 piece of computer software communicates with another. It is a method of achieving abstraction, usually (but not necessarily) between lower-level and higher-level software.
4. AMS: Asset Management System
5. Authentication: Authentication is the process of verifying an identity claimed by or for a system entity.
6. Authorization: Authorization is a right or a permission that is granted to a system entity to access a system resource.
7. Analog range: An analog range is the minimum to maximum value that a device is expected to have in the field. A/D: Analog to digital conversion.
8. AWG: American wire gauge.
9. CCTV: Closed Circuit Television.
10. CFC: California Fire Code.
11. CMMS: Computerized Maintenance Management System
12. COMNET: Clearwater Operations Management Network. COMNET is a dedicated term for City's existing enterprise level of wastewater operation systems.
13. COMC: Central Control Room
14. CoSD: City of San Diego
15. COTS: Commercial off-the-shelf.
16. CPU: Central Processing Unit.
17. CSMA/CD: Carrier Sense Multiple Access with Collision Detection.
18. CSU: Channel Service Unit.
19. D/A: Digital to analog conversion.
20. DCS: Distributed Control System
21. DCSP: Distributed Control System Provider

22. DIN: Department Information Network. DIN is a dedicated term for City's COMNET system. The DIN shall provide connectivity between all Department facilities and resources by virtue of a network which incorporates high-speed fiber, telephone data links and radio technology.
23. DCSLAN: Distributed Control System intra-plant Local Area Network located within the plant to interconnect various controllers, workstations, printers and servers. DCS Tag: Tag assigned to a loop for identification purposes and reference inside DCS and on P&ID's (without plant identifier)
24. DCSWAN: Distributed Control System Wide Area Network, used to connect plant-based DCSs together
25. DHCP: Dynamic Host Configuration Protocol.
26. DIN: Deutsches Institut für Normung eV (German Institute for Standardization; similar to US ANSI)
27. DMZ: Demilitarized Zone. Isolation zone between a protected control network (CN) and external users, such that all production traffic "flowing" between the CN and those external users actually flows through an access control device, such as a firewall.
28. DSU: Data Service Unit.
29. EHWS: Environmentally Hardened Workstation. The EHWS shall have a 316-stainless steel enclosure rated as NEMA 4X. The EHWS shall be configured in the range of 32 to 104 degrees F, and humidity of 95% non-condensing.
30. EMI: electromagnetic interference.
31. ESD: emergency shutdown.
32. Ethernet: Ethernet is a frame-based computer networking technology for local area networks (LANs). It defines wiring and signaling for the physical layer, and frame formats and protocols for the media access control (MAC)/data link layer of the OSI model. Ethernet is mostly standardized as IEEE 802.3.
33. EWS: Engineers Workstation(s)
34. FAT: Factory Acceptance Test. A test conducted at the Vendor premise to ensure operability of a system according to specifications.
35. FCC: U.S. Federal Communications Commission
36. FDDI: Fiber Distributed Data Interface, a protocol used in early version of Emerson Ovation systems.
37. FIN: Facility Information Network. FIN is a dedicated term for City's COMNET system. The FIN shall provide connectivity between the DCS and plant facility management systems. The FIN shall specifically have connectivity to WS and HS devices.
38. FWS: Field Workstation(s).
39. GFCI: Ground-fault circuit interrupting receptacle.
40. HART: Highway Addressable Remote Transducer

41. HMI: Human-Machine Interface. A term that refers to the “layer” that separates a human that is operating a machine from the machine itself. One example of a HMI is the computer hardware and software that enables a single operator to monitor and control large machinery remotely.
42. HOR: Hand-Off-Remote
43. HS: Historian Server.
44. HSE: health and safety equipment.
45. IEC: International Electro-technical Commission, is a European standards body which has developed IEC60870-5 series of SCADA protocols. IEC is now working on IEC-62351 a secure protocol envelope for DNP3 and IEC60870-5.
46. IEEE: Institute of Electrical and Electronics Engineers.
47. I/O: Input and Output: I/O is used by the DCS for receiving and sending signals to and from the field to the DCS. I/O types are:
48. AI: Analog Input
49. AO: Analog Output
50. DI: Digital Input
51. DO: Digital Output
52. I/O Card: Input/Output (I/O) cards refer to the devices used by the DCS to communicate with field devices. I/O cards consist of digital-in (DI), for on/off detection, analog-in (AI), to measure a range of a device in the field, digital-out (DO), to send on-off signals, or analog-out (AO) to control field devices. IP: Internet Protocol. A data-oriented protocol used by source and destination hosts for communicating data across a packet-switched inter- network. Data in an IP inter-network are sent in blocks referred to as packets or datagrams (the terms are basically synonymous in IP).
53. ISA: International Society of Automation
54. ISO: International Organization for Standardization. The International Organization for Standardization, also known as ISO, is global network of the national standards bodies of 156 countries dedicated to technical standards development.
55. IWS: Instructor Workstation(s)
56. LAN: Local Area Network.
57. LIMS: Laboratory Information Management System
58. LCP: Local Control Panel
59. LOR: Local-Off-Remote
60. LOS: Lock-Out Stop
61. L/R: Local/Remote
62. Malware: Malware is malicious software designed to infiltrate or damage a computer system, without the owner's consent. Malware is commonly taken to include computer viruses, worms, Trojan horses, rootkits, spyware and adware.

63. MBC: Metropolitan Biosolids Center
64. MTBF: Mean Time Before Failure
65. MTTR: Mean Time To Repair
66. MOC II: Metropolitan Operations Center
67. MOV: Motor Operated Valve
68. NCWRP: North City Water Reclamation Plant
69. NEC: National Electrical Code
70. NEMA: National Electrical Manufacturers Association
71. NFPA: National Fire Protection Association
72. NIC: Network Interface Card.
73. NMS: Network Management System
74. NIST: National Institute of Standards and Technology
75. NRC: National Research Council
76. NTP: Notice-to-Proceed
77. OPC: Open Connectivity via Open Standards. OPC is open connectivity in industrial automation and the enterprise systems that support industry. Interoperability is assured through the creation and maintenance of open standards specifications. OPC has been termed Object Linking Embedding [OLE] for Process Control or "OLE for Process Control".
78. OPH: Ovation Process Historian. OPH is a dedicated term for City's COMNET system.
79. ORT: Operational Readiness Test
80. OS: Operating System
81. OSC: Ovation Security Center.
82. OSI: Open Systems Interconnection Reference Model (OSI) — The Open Systems Interconnection Reference Model is a layered abstract description for communications and computer network protocol design, developed as part of the Open Systems Interconnect initiative.
83. OSHA: Occupational Safety and Health Standards
84. OWS: Operator Workstation(s)
85. PCM: Process Control Module. PCM is a dedicated term for City's COMNET system. A PCM refers a combination of various modules including central processing unit/modules, network modules, I/O modules, and/or other special modules, these modules are normally located in the same enclosure, and function together to accomplish data acquisition, alarming and implementation of control strategies for a designated process area.
86. P&ID: Piping and Instrumentation Diagram
87. PID: Proportional-Integral-Derivative controller. A standard feedback loop component in industrial control applications. It measures an "output" of a process and controls an "input", with a goal of maintaining the output at a target value, which is called the "setpoint".

88. PIN: Process Information Network. PIN is a dedicated term for the existing COMNET system. The PIN provides connectivity between the WSs, PCMs, and the Historian System (HS) to enable the timely update and archiving of process information and timely control response.
89. PLC: Programmable Logic Controller.
90. PLWTP: Point Loma Wastewater Treatment Plant
91. PMS: Power Monitoring System
92. PPS: Penasquitos Pump Station
93. QA: Quality Assurance
94. QC: Quality Control
95. QoS: Quality of Service
96. RAID: Redundant Array of Independent Disks
97. RDT: Remote Desk Top
98. RDS: Remote Data Server
99. RFP: Request for Proposal
100. RSSI: Receive Signal Strength Indicator
101. RTU: Remote Terminal Unit. An RTU, or Remote Terminal Unit is a device which interfaces objects in the physical world to a DCS or SCADA system by transmitting telemetry data to the system and/or altering the state of connected objects based on control messages received from the system.
102. SBWRP: South Bay Water Reclamation Plant
103. SCADA: Supervisory Control and Data Acquisition.
104. SOP: Standard Operating Procedures
105. SS: Selector Switch
106. S/S: Start/Stop
107. SAT: Site Acceptance Testing
108. SNMP: Simple Network Management Protocol
109. TCP: Transmission Control Protocol
110. TCP/IP: Transmission Control Protocol/Internet Protocol
111. TIA: Telecommunications Industry Association
112. Terminal Server: a hardware device or server that provides terminals (PCs, printers, and other devices) with a common connection point to a local or wide area network.
113. UFC: Uniform Fire Code
114. UL: Underwriters Laboratories
115. UPS: Uninterruptible Power Supply
116. VLAN: Virtual LAN. A virtual LAN, commonly known as a VLAN, is a logically segmented network mapped over physical hardware.
117. VFD: Variable Frequency Drive

118. VoIP: Voice over Internet Protocol (also called VoIP, IP Telephony, Internet telephony, and Digital Phone) is the routing of voice conversations over the Internet or any other IP-based network. The voice data flows over a general-purpose packet-switched network, instead of traditional dedicated, circuit-switched voice transmission lines.
119. VPN: Virtual Private Network. A private, encrypted communications network usually used within a company, or by several different companies or organizations, used for communicating in a software tunnel over a public network.
120. WAN: Wide Area Network
121. WDPF II: Westinghouse Distributed Processing Family, 2nd Generation
122. WiFi: Wireless Fidelity. Short for wireless fidelity and is meant to be used generically when referring of any type of 802.11 network, whether 802.11b/a/g dual-band, etc.
123. WiMax: Worldwide Interoperability of Microwave Access. WiMax is the name commonly given to the IEEE 802.16 standard. A wireless protocol designed for distances as far as 30 miles but more commonly 3 – 5 miles.
124. WS: Workstation(s), see also EWS, FWS, IWS, OWS

B. Types of Variables:

1. Calculated Analog Points (CA): Analog variables computed from inputs, manual inputs, calculated discrete points, and other calculated analog points.
2. Calculated Discrete Points (CD): Discrete variables computed from inputs, manual inputs, calculated analog points, and other calculated discrete points.
3. Manual Inputs (MI): Variables whose values are manually entered, e.g., laboratory data.
4. Process Variables (PV): Analog variables from analog inputs and calculated analog points.
5. Report Variables: Variables computed by report generator.

1.2 RELATED SECTIONS

A. Codes and Standards: The Work shall comply with the current editions of the publication and codes as adopted by the City of San Diego
1. The Greenbook, latest edition.
2. The Whitebook, latest edition.
3. Division 26 – Electrical

6. Division 40 – Process Integration

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END SECTION

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SUPPLEMENTARY SPECIAL PROVISIONS

APPENDICES

APPENDIX A

NOTICE OF EXEMPTION

NOTICE OF EXEMPTION

(Check one or both)

TO: __X__ Recorder/County Clerk
P.O. Box 1750, MS A-33
1600 Pacific Hwy, Room 260
San Diego, CA 92101-2400

_____ Office of Planning and Research
1400 Tenth Street, Room 121
Sacramento, CA 95814

FROM: City of San Diego
Engineering & Capital Projects Department
525 B Street, Suite 750, MS 908A
San Diego, CA 92101

Project Name: Metro Biosolids Center Gas Detection System Replacement **WBS No.:** B-20121.02.06

Project Location-Specific: The project is located at the Metro Biosolids Center, 5240 Convoy Street, within the Military Facilities Area (Council District 6).

Project Location-City/County: San Diego/San Diego

Description of nature and purpose of the Project: The project involves replacement of the existing gas detection system within the Metro Biosolids Center (MBC) wastewater treatment facility, including gas monitoring panels, gas sensors, electrical conduit, and conductors. The project involves no trenching or subsurface ground disturbance, and no impacts to existing on-site vegetation. All work will occur within the developed MBC facility.

Name of Public Agency Approving Project: City of San Diego

Name of Person or Agency Carrying Out Project: City of San Diego
Engineering & Capital Projects Department
Contact: Jerry Jakubauskas
Email: JJakubauskas@sandiego.gov / Phone: (619) 533-3755
525 B Street, Suite 750 (MS 908A), San Diego, CA 92101

Exempt Status: (CHECK ONE)

( ) Ministerial (Sec. 21080(b)(1); 15268);
( ) Declared Emergency (Sec. 21080(b)(3); 15269(a));
( ) Emergency Project (Sec. 21080(b)(4); 15269 (b)(c))
(X) Categorical Exemption: 15301 (Existing Facilities); and 15302 (Replacement or Reconstruction)

Reasons why project is exempt: The City of San Diego conducted an environmental review which determined that the project meets the categorical exemption criteria set forth in CEQA State Guidelines, Section 15301 (Existing Facilities), which allows for the operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public facilities involving negligible or no expansion of use beyond that existing at the time of the lead agency's determination, including existing publicly-owned utilities used to provide electric power, natural gas, sewerage, or other public utility services (gas detection system replacement is a minor alteration to the existing facility); and Section 15302 (Replacement or Reconstruction), which consists of replacement or reconstruction of existing structures and facilities where the new structure will be located on the same site, including replacement or reconstruction of existing utility systems and/or facilities involving negligible or no expansion of capacity (new gas detection equipment is a replacement of existing equipment within the facility); and, where the exceptions listed in Section 15300.2 would not apply.

Lead Agency Contact Person: Jerry Jakubauskas **Telephone**: (619) 533-3755

If filed by applicant:

1. Attach certified document of exemption finding.
2. Has a notice of exemption been filed by the public agency approving the project? ( ) Yes ( ) No

It is hereby certified that the City of San Diego has determined the above activity to be exempt from CEQA

Carrie Purcell
Carrie Purcell, Interim Deputy Director

12/13/21
Date

Check One:
(X) Signed By Lead Agency
( ) Signed by Applicant

Date Received for Filing with County Clerk or OPR:

APPENDIX B

FIRE HYDRANT METER PROGRAM

CITY OF SAN DIEGO CALIFORNIA DEPARTMENT INSTRUCTIONS	NUMBER **DI** 55.27	DEPARTMENT Water Department
SUBJECT **FIRE HYDRANT METER PROGRAM (FORMERLY: CONSTRUCTION METER PROGRAM)**	**PAGE** 1 **OF** 10	**EFFECTIVE DATE** October 15, 2002
	SUPERSEDES **DI** 55.27	**DATED** April 21, 2000

1. **PURPOSE**

1.1 To establish a Departmental policy and procedure for issuance, proper usage and charges for fire hydrant meters.

2. **AUTHORITY**

2.1 All authorities and references shall be current versions and revisions.

2.2 San Diego Municipal Code (NC) Chapter VI, Article 7, Sections 67.14 and 67.15

2.3 Code of Federal Regulations, Safe Drinking Water Act of 1986

2.4 California Code of Regulations, Titles 17 and 22

2.5 California State Penal Code, Section 498B.0

2.6 State of California Water Code, Section 110, 500-6, and 520-23

2.7 Water Department Director

Reference

2.8 State of California Guidance Manual for Cross Connection Programs

2.9 American Water Works Association Manual M-14, Recommended Practice for Backflow Prevention

2.10 American Water Works Association Standards for Water Meters

2.11 U.S.C. Foundation for Cross Connection Control and Hydraulic Research Manual

3. **DEFINITIONS**

3.1 **Fire Hydrant Meter:** A portable water meter which is connected to a fire hydrant for the purpose of temporary use. (These meters are sometimes referred to as Construction Meters.)

3.2 **Temporary Water Use:** Water provided to the customer for no longer than twelve (12) months.

3.3 **Backflow Preventor:** A Reduced Pressure Principal Assembly connected to the outlet side of a Fire Hydrant Meter.

4. POLICY

4.1 The Water Department shall collect a deposit from every customer requiring a fire hydrant meter and appurtenances prior to providing the meter and appurtenances (see Section 7.1 regarding the Fees and Deposit Schedule). The deposit is refundable upon the termination of use and return of equipment and appurtenances in good working condition.

4.2 Fire hydrant meters will have a 2 ½" swivel connection between the meter and fire hydrant. The meter shall not be connected to the 4" port on the hydrant. All Fire Hydrant Meters issued shall have a Reduced Pressure Principle Assembly (RP) as part of the installation. Spanner wrenches are the only tool allowed to turn on water at the fire hydrant.

4.3 The use of private hydrant meters on City hydrants is prohibited, with exceptions as noted below. All private fire hydrant meters are to be phased out of the City of San Diego. All customers who wish to continue to use their own fire hydrant meters must adhere to the following conditions:

a. Meters shall meet all City specifications and American Water Works Association (AWWA) standards.

b. Customers currently using private fire hydrant meters in the City of San Diego water system will be allowed to continue using the meter under the following conditions:

1. The customer must submit a current certificate of accuracy and calibration results for private meters and private backflows annually to the City of San Diego, Water Department, Meter Shop.

2. The meter must be properly identifiable with a clearly labeled serial number on the body of the fire hydrant meter. The serial number shall be plainly stamped on the register lid and the main casing. Serial numbers shall be visible from the top of the meter casing and the numbers shall be stamped on the top of the inlet casing flange.

3. All meters shall be locked to the fire hydrant by the Water Department, Meter Section (see Section 4.7).

4. All meters shall be read by the Water Department, Meter Section (see Section 4.7).

5. All meters shall be relocated by the Water Department, Meter Section (see Section 4.7).

6. These meters shall be tested on the anniversary of the original test date and proof of testing will be submitted to the Water Department, Meter Shop, on a yearly basis. If not tested, the meter will not be allowed for use in the City of San Diego.

7. All private fire hydrant meters shall have backflow devices attached when installed.

8. The customer must maintain and repair their own private meters and private backflows.

9. The customer must provide current test and calibration results to the Water Department, Meter Shop after any repairs.

10. When private meters are damaged beyond repair, these private meters will be replaced by City owned fire hydrant meters.

11. When a private meter malfunctions, the customer will be notified and the meter will be removed by the City and returned to the customer for repairs. Testing and calibration results shall be given to the City prior to any re-installation.

12. The register shall be hermetically sealed straight reading and shall be readable from the inlet side. Registration shall be in hundred cubic feet.

13. The outlet shall have a 2 ½ "National Standards Tested (NST) fire hydrant male coupling.

14. Private fire hydrant meters shall not be transferable from one contracting company to another (i.e. if a company goes out of business or is bought out by another company).

4.4 All fire hydrant meters and appurtenances shall be installed, relocated and removed by the City of San Diego, Water Department. All City owned fire hydrant meters and appurtenances shall be maintained by the City of San Diego, Water Department, Meter Services.

4.5 If any fire hydrant meter is used in violation of this Department Instruction, the violation will be reported to the Code Compliance Section for investigation and appropriate action. Any customer using a fire hydrant meter in violation of the requirements set forth above is subject to fines or penalties pursuant to the Municipal Code, Section 67.15 and Section 67.37.

4.6 **Conditions and Processes for Issuance of a Fire Hydrant Meter**

Process for Issuance

a. Fire hydrant meters shall only be used for the following purposes:

1. Temporary irrigation purposes not to exceed one year.

2. Construction and maintenance related activities (see Tab 2).

b. No customer inside or outside the boundaries of the City of San Diego Water Department shall resell any portion of the water delivered through a fire hydrant by the City of San Diego Water Department.

c. The City of San Diego allows for the issuance of a temporary fire hydrant meter for a period not to exceed 12 months (365 days). An extension can only be granted in writing from the Water Department Director for up to 90 additional days. A written request for an extension by the consumer must be submitted at least 30 days prior to the 12 month period ending. No extension shall be granted to any customer with a delinquent account with the Water Department. No further extensions shall be granted.

d. Any customer requesting the issuance of a fire hydrant meter shall file an application with the Meter Section. The customer must complete a "Fire Hydrant Meter Application" (Tab 1) which includes the name of the company, the party responsible for payment, Social Security number and/or California ID, requested location of the meter (a detailed map signifying an exact location), local contact person, local phone number, a contractor's license (or a business license), description of specific water use, duration of use at the site and full name and address of the person responsible for payment.

e. At the time of the application the customer will pay their fees according to the schedule set forth in the Rate Book of Fees and Charges, located in the City Clerk's Office. All fees must be paid by check, money order or cashiers check, made payable to the City Treasurer. Cash will not be accepted.

f. No fire hydrant meters shall be furnished or relocated for any customer with a delinquent account with the Water Department.

g. After the fees have been paid and an account has been created, the

meter shall be installed within 48 hours (by the second business day). For an additional fee, at overtime rates, meters can be installed within 24 hours (within one business day).

4.7 **Relocation of Existing Fire Hydrant Meters**

a. The customer shall call the Fire Hydrant Meter Hotline (herein referred to as "Hotline"), a minimum of 24 hours in advance, to request the relocation of a meter. A fee will be charged to the existing account, which must be current before a work order is generated for the meter's relocation.

b. The customer will supply in writing the address where the meter is to be relocated (map page, cross street, etc). The customer must update the original Fire Hydrant Meter Application with any changes as it applies to the new location.

c. Fire hydrant meters shall be read on a monthly basis. While fire hydrant meters and backflow devices are in service, commodity, base fee and damage charges, if applicable, will be billed to the customer on a monthly basis. If the account becomes delinquent, the meter will be removed.

4.8 **Disconnection of Fire Hydrant Meter**

a. After ten (10) months a "Notice of Discontinuation of Service" (Tab 3) will be issued to the site and the address of record to notify the customer of the date of discontinuance of service. An extension can only be granted in writing from the Water Department Director for up to 90 additional days (as stated in Section 4.6C) and a copy of the extension shall be forwarded to the Meter Shop Supervisor. If an extension has not been approved, the meter will be removed after twelve (12) months of use.

b. Upon completion of the project the customer will notify the Meter Services office via the Hotline to request the removal of the fire hydrant meter and appurtenances. A work order will be generated

for removal of the meter.

c. Meter Section staff will remove the meter and backflow prevention assembly and return it to the Meter Shop. Once returned to the Meter Shop the meter and backflow will be tested for accuracy and functionality.

d. Meter Section Staff will contact and notify Customer Services of the final read and any charges resulting from damages to the meter and backflow or its appurtenance. These charges will be added on the customer's final bill and will be sent to the address of record. Any customer who has an outstanding balance will not receive additional meters.

e. Outstanding balances due may be deducted from deposits and any balances refunded to the customer. Any outstanding balances will be turned over to the City Treasurer for collection. Outstanding balances may also be transferred to any other existing accounts.

5. EXCEPTIONS

5.1 Any request for exceptions to this policy shall be presented, in writing, to the Customer Support Deputy Director, or his/her designee for consideration.

6. MOBILE METER

6.1 Mobile meters will be allowed on a case by case basis. All mobile meters will be protected by an approved backflow assembly and the minimum requirement will be a Reduced Pressure Principal Assembly. The two types of Mobile Meters are vehicle mounted and floating meters. Each style of meters has separate guidelines that shall be followed for the customer to retain service and are described below:

a) **Vehicle Mounted Meters**: Customer applies for and receives a City owned Fire Hydrant Meter from the Meter Shop. The customer mounts the meter on the vehicle and brings it to the Meter Shop for

inspection. After installation is approved by the Meter Shop the vehicle and meter shall be brought to the Meter Shop on a monthly basis for meter reading and on a quarterly basis for testing of the backflow assembly. Meters mounted at the owner's expense shall have the one year contract expiration waived and shall have meter or backflow changed if either fails.

b) **Floating Meters**: Floating Meters are meters that are not mounted to a vehicle. **(Note: All floating meters shall have an approved backflow assembly attached.)** The customer shall submit an application and a letter explaining the need for a floating meter to the Meter Shop. The Fire Hydrant Meter Administrator, after a thorough review of the needs of the customer, (i.e. number of jobsites per day, City contract work, lack of mounting area on work vehicle, etc.), may issue a floating meter. At the time of issue, it will be necessary for the customer to complete and sign the "Floating Fire Hydrant Meter Agreement" which states the following:

    1) The meter will be brought to the Meter Shop at 2797 Caminito Chollas, San Diego on the third week of each month for the monthly read by Meter Shop personnel.

    2) Every other month the meter will be read and the backflow will be tested. This date will be determined by the start date of the agreement.

If any of the conditions stated above are not met the Meter Shop has the right to cancel the contract for floating meter use and close the account associated with the meter. The Meter Shop will also exercise the right to refuse the issuance of another floating meter to the company in question.

Any Fire Hydrant Meter using reclaimed water shall not be allowed use again with any potable water supply. The customer shall incur the cost of replacing the meter and backflow device in this instance.

7. FEE AND DEPOSIT SCHEDULES

7.1 **Fees and Deposit Schedules:** The fees and deposits, as listed in the Rate Book of Fees and Charges, on file with the Office of the City Clerk, are based on actual reimbursement of costs of services performed, equipment and materials. Theses deposits and fees will be amended, as needed, based on actual costs. Deposits, will be refunded at the end of the use of the fire hydrant meter, upon return of equipment in good working condition and all outstanding balances on account are paid. Deposits can also be used to cover outstanding balances.

All fees for equipment, installation, testing, relocation and other costs related to this program are subject to change without prior notification. The Mayor and Council will be notified of any future changes.

8. UNAUTHORIZED USE OF WATER FROM A HYDRANT

8.1 Use of water from any fire hydrant without a properly issued and installed fire hydrant meter is theft of City property. Customers who use water for unauthorized purposes or without a City of San Diego issued meter will be prosecuted.

8.2 If any unauthorized connection, disconnection or relocation of a fire hydrant meter, or other connection device is made by anyone other than authorized Water Department personnel, the person making the connection will be prosecuted for a violation of San Diego Municipal Code, Section 67.15. In the case of a second offense, the customer's fire hydrant meter shall be confiscated and/or the deposit will be forfeited.

8.3 Unauthorized water use shall be billed to the responsible party. Water use charges shall be based on meter readings, or estimates when meter readings are not available.

8.4 In case of unauthorized water use, the customer shall be billed for all applicable charges as if proper authorization for the water use had been obtained, including but not limited to bi-monthly service charges, installation charges and removal charges.

8.5 If damage occurs to Water Department property (i.e. fire hydrant meter, backflow, various appurtenances), the cost of repairs or replacements will be charged to the customer of record (applicant).

Water Department Director

Tabs: 1. Fire Hydrant Meter Application
2. Construction & Maintenance Related Activities With No Return To Sewer
3. Notice of Discontinuation of Service

APPENDIX

Administering Division: Customer Support Division

Subject Index:
Construction Meters
Fire Hydrant
Fire Hydrant Meter Program
Meters, Floating or Vehicle Mounted
Mobile Meter
Program, Fire Hydrant Meter

Distribution: DI Manual Holders

City of San Diego
PUBLIC UTILITIES
Water & Wastewater

Application for Fire Hydrant Meter (EXHIBIT A)

(For Office Use Only)

NS REQ	FAC#
DATE	BY

METER SHOP (619) 527-7449

Application Date	Requested Install Date:

Meter Information

Fire Hydrant Location: (Attach Detailed Map//Thomas Bros. Map Location or Construction drawing.) Zip:	T.B.	G.B. (CITY USE)
Specific Use of Water:		
Any Return to Sewer or Storm Drain, If so , explain:		
Estimated Duration of Meter Use: ☐ Check Box if Reclaimed Water		

Company Information

Company Name:			
Mailing Address:			
City:	State:	Zip:	Phone: ( )
*Business license#	*Contractor license#		
A Copy of the Contractor's license OR Business License is required at the time of meter issuance.			
Name and Title of Billing Agent: (PERSON IN ACCOUNTS PAYABLE)			Phone: ( )
Site Contact Name and Title:			Phone: ( )
Responsible Party Name:			Title:
Cal ID#			Phone: ( )
Signature:		Date:	

Guarantees Payment of all Charges Resulting from the use of this Meter. Insures that employees of this Organization understand the proper use of Fire Hydrant Meter

☐ Fire Hydrant Meter Removal Request		Requested Removal Date:
Provide Current Meter Location if Different from Above:		
Signature:	Title:	Date:
Phone: ( )	Pager: ( )	

☐ City Meter ☐ Private Meter		
Contract Acct #:	Deposit Amount: $ 936.00	Fees Amount: $ 62.00
Meter Serial #	Meter Size: 05	Meter Make and Style: 6-7
Backflow #	Backflow Size:	Backflow Make and Style:
Name:	Signature:	Date:

WATER USES WITHOUT ANTICIPATED CHARGES FOR RETURN TO SEWER

Auto Detailing
Backfilling
Combination Cleaners (Vactors)
Compaction
Concrete Cutters
Construction Trailers
Cross Connection Testing
Dust Control
Flushing Water Mains
Hydro Blasting
Hydro Seeing
Irrigation (for establishing irrigation only; not continuing irrigation)
Mixing Concrete
Mobile Car Washing
Special Events
Street Sweeping
Water Tanks
Water Trucks
Window Washing

Note:

1. If there is any return to sewer or storm drain, then sewer and/or storm drain fees will be charges.

Date

Name of Responsible Party
Company Name and Address
Account Number:_____

Subject: Discontinuation of Fire Hydrant Meter Service

Dear Water Department Customer:

The authorization for use of Fire Hydrant Meter #_____, located at *(Meter Location Address)* ends in 60 days and will be removed on or after *(Date Authorization Expires)*. Extension requests for an additional 90 days must be submitted in writing for consideration 30 days prior to the discontinuation date. If you require an extension, please contact the Water Department, or mail your request for an extension to:

City of San Diego
Water Department
Attention: Meter Services
2797 Caminito Chollas
San Diego, CA 92105-5097

Should you have any questions regarding this matter, please call the Fire Hydrant Hotline at (619)_____-_____.

Sincerely,

Water Department

APPENDIX C

MATERIALS TYPICALLY ACCEPTED BY CERTIFICATE OF COMPLIANCE

MATERIALS TYPICALLY ACCEPTED BY CERTIFICATE OF COMPLIANCE

1. Soil amendment
2. Fiber mulch
3. PVC or PE pipe up to 16 inch diameter
4. Stabilizing emulsion
5. Lime
6. Preformed elastomeric joint seal
7. Plain and fabric reinforced elastomeric bearing pads
8. Steel reinforced elastomeric bearing pads
9. Waterstops (Special Condition)
10. Epoxy coated bar reinforcement
11. Plain and reinforcing steel
12. Structural steel
13. Structural timber and lumber
14. Treated timber and lumber
15. Lumber and timber
16. Aluminum pipe and aluminum pipe arch
17. Corrugated steel pipe and corrugated steel pipe arch
18. Structural metal plate pipe arches and pipe arches
19. Perforated steel pipe
20. Aluminum underdrain pipe
21. Aluminum or steel entrance tapers, pipe downdrains, reducers, coupling bands and slip joints
22. Metal target plates
23. Paint (traffic striping)
24. Conductors
25. Painting of electrical equipment
26. Electrical components
27. Engineering fabric
28. Portland Cement
29. PCC admixtures
30. Minor concrete, asphalt
31. Asphalt (oil)
32. Liquid asphalt emulsion
33. Epoxy

APPENDIX D

SAMPLE CITY INVOICE WITH CASH FLOW FORECAST

City of San Diego, CM&FS Div., 9753 Chesapeake Drive, SD CA 92123

Project Name:

Work Order No or Job Order No.

City Purchase Order No.

Resident Engineer (RE):

RE Phone#: Fax#:

Contractor's Name:

Contractor's Address:

Contractor's Phone #:

Contractor's fax #:

Contact Name:

Invoice No.

Invoice Date:

Billing Period: (To)

Item #	Item Description	Contract Authorization				Previous Totals To Date		This Estimate		Totals to Date	
		Unit	Price	Qty	Extension	%/QTY	Amount	% / QTY	Amount	% / QTY	Amount
1					$ -		$ -		$ -	0.00	$ -
2					$ -		$ -		$ -	0.00%	$ -
3					$ -		$ -		$ -	0.00%	$ -
4					$ -		$ -		$ -	0.00%	$ -
5					$ -		$ -		$ -	0.00%	$ -
6					$ -		$ -		$ -	0.00%	$ -
7					$ -		$ -		$ -	0.00%	$ -
8					$ -		$ -		$ -	0.00%	$ -
5					$ -		$ -		$ -	0.00%	$ -
6					$ -		$ -		$ -	0.00%	$ -
7					$ -		$ -		$ -	0.00%	$ -
8					$ -		$ -		$ -	0.00%	$ -
9					$ -		$ -		$ -	0.00%	$ -
10					$ -		$ -		$ -	0.00%	$ -
11					$ -		$ -		$ -	0.00%	$ -
12					$ -		$ -		$ -	0.00%	$ -
13					$ -		$ -		$ -	0.00%	$ -
14					$ -		$ -		$ -	0.00%	$ -
15					$ -		$ -		$ -	0.00%	$ -
16					$ -		$ -		$ -	0.00%	$ -
17	**Field Orders**				$ -		$ -		$ -	0.00%	$ -
					$ -		$ -		$ -	0.00%	$ -
	CHANGE ORDER No.				$ -		$ -		$ -	0.00%	$ -
					$ -		$ -		$ -	0.00%	$ -
	Total Authorized Amount (including approved Change Order)				**$ -**		**$ -**		$ -	**Total Billed**	$ -

SUMMARY

A. Original Contract Amount	$ -
B. Approved Change Order #00 Thru #00	$ -
C. Total Authorized Amount (A+B)	$ -
D. Total Billed to Date	$ -
E. Less Total Retention (5% of D)	$ -
F. Less Total Previous Payments	$ -
G. Payment Due Less Retention	**$0.00**
H. Remaining Authorized Amount	$0.00

I certify that the materials have been received by me in the quality and quantity specified

_____

Resident Engineer

_____

Construction Engineer

Retention and/or Escrow Payment Schedule

Total Retention Required as of this billing (Item E)	$0.00
Previous Retention Withheld in PO or in Escrow	$0.00
Add'l Amt to Withhold in PO/Transfer in Escrow:	***$0.00***
Amt to Release to Contractor from PO/Escrow:	

Contractor Signature and Date: _____

NOTE: CONTRACTOR TO CALCULATE TO THE 2ND DECIMAL PLACE.

WBS #:	B18108
Date Submitted:	10/10/2018
NTP Date:	3/23/2018
Final Statement of WD Date:	5/23/2020
Contract #:	K-XX-XXXX-XXX-X
Contract Amount:	$5,617,000

Construction Cash Flow Forecast

"Sewer and Water Group Job 965 (W)"

Year	January	February	March	April	May	June	July	August	September	October	November	December
2018				15,000	25,000	52,000	52,000	100,000	10,000	100,000	100,000	100,000
2019	10,000	10,000	85,000	58,000	100,000	100,000	100,000	100,000	100,000	100,000	1,000,000	1,000,000
2020	100,000	100,000	100,000	1,000,000	1,000,000							
2021												
2022												
2023												
2024												
2025												

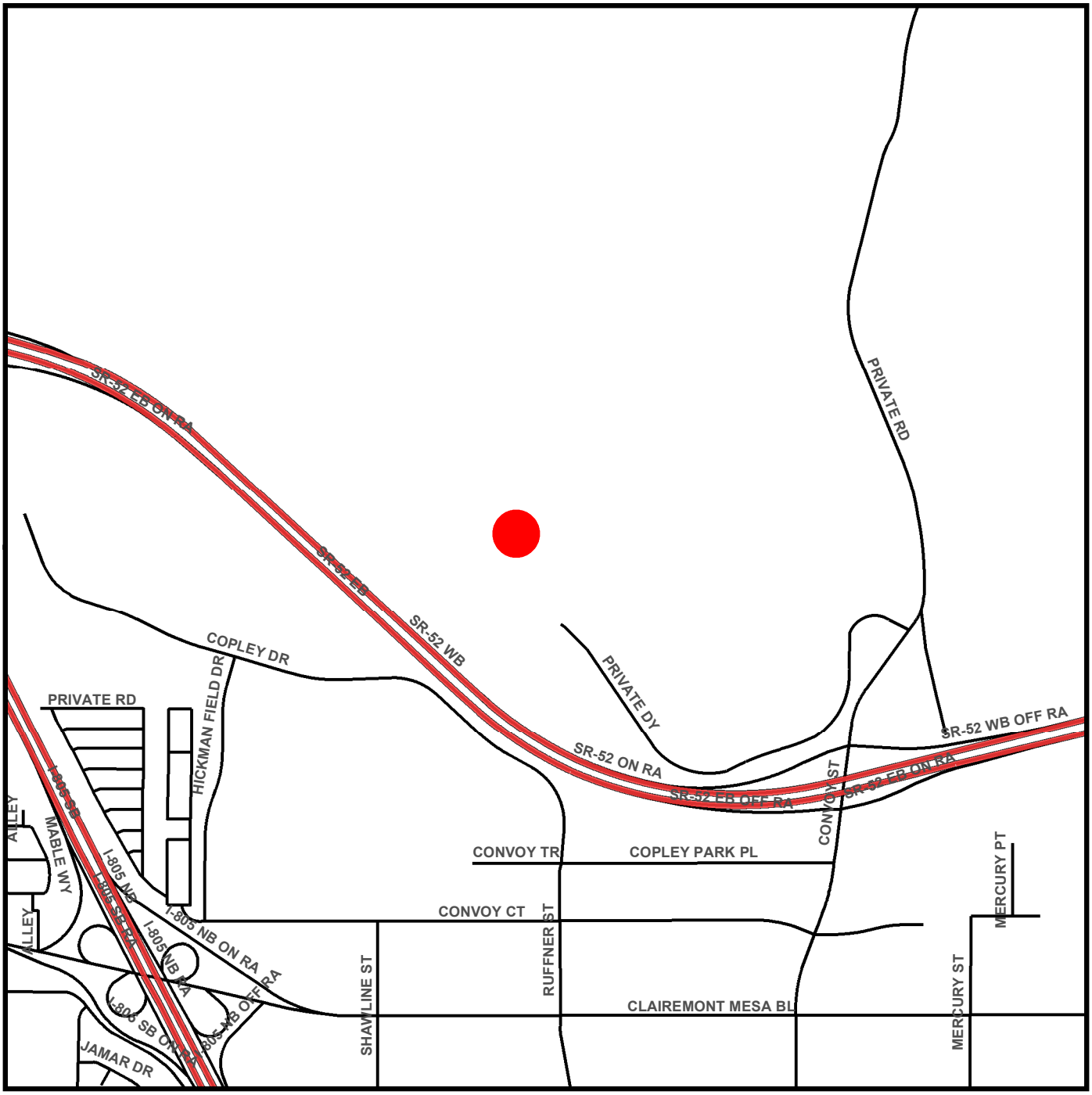
APPENDIX E

LOCATION MAP

The City of SAN DIEGO Public Works

MBC GAS DETECTION SYSTEM REPLACEMENT PROJECT

SENIOR ENGINEER	PROJECT MANAGER	PROJECT ENGINEER	FOR QUESTIONS ABOUT THIS PROJECT
Brian Vitalle	Idalmiro Manuel da Rosa	Jorge A Larriva	Call: 619-533-4207
619-533-5105	619-533-4629	619-533-7405	Email: engineering@sandiego.gov



MBC Gas Sensors Replacement Project

N W E S

No Scale

COUNCIL DISTRICT: 6

SanGIS

COMMUNITY NAME: MCAS Miramar

SAP ID: B20121 (S)

Date: October 14, 2020

APPENDIX F

SAMPLE OF PUBLIC NOTICE

The City of SAN DIEGO

CONSTRUCTION NOTICE

PROJECT TITLE

Work on your street will begin within one week to replace the existing water mains servicing your community.

The work will consist of:

- Saw-cutting and trench work on Ingulf Street from Morena Boulevard to Galveston Street to install new water mains, water laterals and fire hydrants.
- Streets where trenching takes place will be resurfaced and curb ramps will be upgraded to facilitate access for persons with disabilities where required.
- This work is anticipated to be complete in your community by December 2016.

How your neighborhood may be impacted:

- Water service to some properties during construction will be provided by a two-inch highline pipe that will run along the curb. To report a highline leak call 619-515-3525.
- Temporary water service disruptions are planned. If planned disruptions impact your property, you will receive advance notice.
- Parking restrictions will exist because of the presence of construction equipment and materials.
- "No Parking" signs will be displayed 72 hours in advance of the work.
- Cars parked in violation of signs will be TOWED.

Hours and Days of Operation:
Monday through Friday X:XX AM to X:XX PM.

City of San Diego Contractor:
Company Name, XXX-XXX-XXXX

To contact the City of San Diego: SD Public Works
619-533-4207 | engineering@sandiego.gov | sandiego.gov/CIP

This information is available in alternative formats upon request.

The City of SAN DIEGO

CONSTRUCTION NOTICE

PROJECT TITLE

Work on your street will begin within one week to replace the existing water mains servicing your community.

The work will consist of:

- Saw-cutting and trench work on Ingulf Street from Morena Boulevard to Galveston Street to install new water mains, water laterals and fire hydrants.
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City of San Diego Contractor:
Company Name, XXX-XXX-XXXX

To contact the City of San Diego: SD Public Works
619-533-4207 | engineering@sandiego.gov | sandiego.gov/CIP

This information is available in alternative formats upon request.

ATTACHMENT F

RESERVED

ATTACHMENT G

CONTRACT AGREEMENT

ATTACHMENT G

CONTRACT AGREEMENT

CONSTRUCTION CONTRACT

This Phase-Funded contract is made and entered into between THE CITY OF SAN DIEGO, a municipal corporation, herein called "City", and Southern Contracting Co., herein called "Contractor" for construction of **MBC Gas Detection System Replacement**; Bid No. **K-23-2127-DBB-3;** in the total amount Three Million Nine Hundred Seven Thousand Ten Dollars and Zero Cents ($3,907,010.00), which is comprised of $1,700,000.00 for Phase I and $2,207,010.00 for Phase II.

IN CONSIDERATION of the payments to be made hereunder and the mutual undertakings of the parties hereto, City and Contractor agree as follows:

1. The following are incorporated into this contract as though fully set forth herein:

   (a) The attached Faithful Performance and Payment Bonds.

   (b) The attached Proposal included in the Bid documents by the Contractor.

   (c) Reference Standards listed in the Instruction to Bidders and the Supplementary Special Provisions (SSP).

   (d) Phased Funding Schedule Agreement.

   (e) That certain documents entitled **MBC Gas Detection System Replacement**, on file in the office of the Purchasing & Contracting Department as Document No. **B-20121**, as well as all matters referenced therein.

2. The City wishes to construct this Project on a Phase-Funded basis. In accordance with Whitebook section 7-3.10, the City is only obligated to pay for Phase I; Contractor cannot begin, nor is the City financially liable for any additional Phases, unless and until Contractor is issued a Notice to Proceed for each additional Phase by the City.

3. The Contractor shall perform and be bound by all the terms and conditions of this contract and in strict conformity therewith shall perform and complete in a good and workmanlike manner **MBC Gas Detection System Replacement**, Bid Number **K-23-2127-DBB-3,** San Diego, California.

4. For such performances, the City shall pay to Contractor the amounts set forth at the times and in the manner and with such additions or deductions as are provided for in this contract, and the Contractor shall accept such payment in full satisfaction of all claims incident to such performances. (See WHITEBOOK, Section 7-3.10, Phased Funding Compensation).

CONTRACT AGREEMENT (continued)

5. No claim or suit whatsoever shall be made or brought by Contractor against any officer, agent, or employee of the City for or on account of anything done or omitted to be done in connection with this contract, nor shall any such officer, agent, or employee be liable hereunder.

6. This contract is effective as of the date that the Mayor or designee signs the agreement and is approved by the City Attorney in accordance with San Diego Charter Section 40.

IN WITNESS WHEREOF, this Agreement is signed by the City of San Diego, acting by and through its Mayor or designee, pursuant to Municipal Code Section 22.3102 authorizing such execution.

THE CITY OF SAN DIEGO

By _____

Print Name: Stephen Samara
Principal Contract Specialist
Purchasing & Contracting Department

Date: 7/11/2023

APPROVED AS TO FORM

Mara W. Elliott, City Attorney

By _____

Print Name: Dena Fairchild
Deputy City Attorney

Date: 7/14/2023

CONTRACTOR Southern Contracting Company

By _____

Print Name: Philip E. Waterman

Title: President

Date: 7/7/2023

City of San Diego License No.: B1974004617

State Contractor's License No.: 222252

DEPARTMENT OF INDUSTRIAL RELATIONS (DIR) REGISTRATION NUMBER: 1000002172

CERTIFICATIONS AND FORMS

The Bidder, by submitting its electronic bid, agrees to and certifies under penalty of perjury under the laws of the State of California, that the certifications, forms and affidavits submitted as part of this bid are true and correct.

BIDDER'S GENERAL INFORMATION

To the City of San Diego:

Pursuant to "Notice Inviting Bids", specifications, and requirements on file with the City Clerk, and subject to all provisions of the Charter and Ordinances of the City of San Diego and applicable laws and regulations of the United States and the State of California, the undersigned hereby proposes to furnish to the City of San Diego, complete at the prices stated herein, the items or services hereinafter mentioned. The undersigned further warrants that this bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

The undersigned bidder(s) further warrants that bidder(s) has thoroughly examined and understands the entire Contract Documents (plans and specifications) and the Bidding Documents therefore, and that by submitting said Bidding Documents as its bid proposal, bidder(s) acknowledges and is bound by the entire Contract Documents, including any addenda issued thereto, as such Contract Documents incorporated by reference in the Bidding Documents.

NON-COLLUSION AFFIDAVIT TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID UNDER 23 UNITED STATES CODE 112 AND PUBLIC CONTRACT CODE 7106

State of California

County of San Diego

The bidder, being first duly sworn, deposes and says that he or she is authorized by the party making the foregoing bid that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

CONTRACTOR CERTIFICATION

DRUG-FREE WORKPLACE

I hereby certify that I am familiar with the requirements of San Diego City Council Policy No. 100-17 regarding Drug-Free Workplace as outlined in the WHITEBOOK, Section 5-1.3, "Drug-Free Workplace", of the project specifications, and that;

This company has in place a drug-free workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of subdivisions a) through c) of the policy as outlined.

CONTRACTOR CERTIFICATION

AMERICANS WITH DISABILITIES ACT (ADA) COMPLIANCE CERTIFICATION

I hereby certify that I am familiar with the requirements of San Diego City Council Policy No. 100-4 regarding the Americans With Disabilities Act (ADA) outlined in the WHITEBOOK, Section 5-1.2, "California Building Code, California Code of Regulations Title 24 and Americans with Disabilities Act". of the project specifications, and that:

This company has in place workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of the policy as outlined.

CONTRACTOR CERTIFICATION

CONTRACTOR STANDARDS – PLEDGE OF COMPLIANCE

I declare under penalty of perjury that I am authorized to make this certification on behalf of the company submitting this bid/proposal, that as Contractor, I am familiar with the requirements of City of San Diego Municipal Code § 22.3004 regarding Contractor Standards as outlined in the WHITEBOOK, Section 5-1.4, ("Contractor Standards and Pledge of Compliance"), of the project specifications, and that Contractor has complied with those requirements.

I further certify that each of the Contractor's subcontractors has completed a Pledge of Compliance attesting under penalty of perjury of having complied with City of San Diego Municipal Code § 22.3004.

CONTRACTOR CERTIFICATION

EQUAL BENEFITS ORDINANCE CERTIFICATION

I declare under penalty of perjury that I am familiar with the requirements of and in compliance with the City of San Diego Municipal Code § 22.4300 regarding Equal Benefits Ordinance.

CONTRACTOR CERTIFICATION

EQUAL PAY ORDINANCE CERTIFICATION

Contractor shall comply with the Equal Pay Ordinance (EPO) codified in the San Diego Municipal Code (SDMC) at section 22.4801 through 22.4809, unless compliance is not required based on an exception listed in SDMC section 22.4804.

Contractor shall require all of its subcontractors to certify compliance with the EPO in their written subcontracts.

Contractor must post a notice informing its employees of their rights under the EPO in the workplace or job site.

By signing this Contract with the City of San Diego, Contractor acknowledges the EPO requirements and pledges ongoing compliance with the requirements of SDMC Division 48, section 22.4801 et seq., throughout the duration of this Contract.

CONTRACTOR CERTIFICATION

PRODUCT ENDORSEMENT

I declare under penalty of perjury that I acknowledge and agree to comply with the provisions of City of San Diego Administrative Regulation 95.65, concerning product endorsement. Any advertisement identifying or referring to the City as the user of a product or service requires the prior written approval of the City.

AFFIDAVIT OF DISPOSAL

(To be submitted upon completion of Construction pursuant to the contracts Certificate of Completion)

WHEREAS, on the _____ DAY OF _____, 2_____ the undersigned entered into and executed a contract with the City of San Diego, a municipal corporation, for:

MBC Gas Detection System Replacement
(Project Title)

as particularly described in said contract and identified as Bid No. **K-23-2127-DBB-3**; SAP No. (WBS) **B-20121**; and **WHEREAS**, the specification of said contract requires the Contractor to affirm that "all brush, trash, debris, and surplus materials resulting from this project have been disposed of in a legal manner"; and **WHEREAS**, said contract has been completed and all surplus materials disposed of:

_____

_____

NOW, THEREFORE, in consideration of the final payment by the City of San Diego to said Contractor under the terms of said contract, the undersigned Contractor, does hereby affirm that all surplus materials as described in said contract have been disposed of at the following location(s)

_____

_____

and that they have been disposed of according to all applicable laws and regulations.

Dated this _____ DAY OF _____, _____.

By:_____
Contractor

ATTEST:

State of _____ County of _____

On this_____ DAY OF _____, 2_____, before the undersigned, a Notary Public in and for said County and State, duly commissioned and sworn, personally appeared_____ known to me to be the _____ Contractor named in the foregoing Release, and whose name is subscribed thereto, and acknowledged to me that said Contractor executed the said Release.

Notary Public in and for said County and State

LIST OF SUBCONTRACTORS

***** PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY *** TO BE SUBMITTED IN ELECTRONIC FORMAT ONLY*** SEE INSTRUCTIONS TO BIDDERS, FOR FURTHER INFORMATION**

In accordance with the requirements of the "Subletting and Subcontracting Fair Practices Act", Section 4100, of the California Public Contract Code (PCC), the Bidder is to list below the name, address and license number of each Subcontractor who will perform work, labor, render services or specially fabricate and install a portion [type] of the work or improvement, in an amount of or in excess of 0.5% of the Contractor's total Bid. Failure to comply with this requirement may result in the Bid being rejected as non-responsive. The Contractor is to list only one Subcontractor for each portion of the Work. The Bidder's attention is directed to the Special Provisions – General; Paragraph 2-3 Subcontracts, which stipulates the percentage of the Work to be performed with the Bidder's own forces. The Bidder is to also list all SLBE, ELBE, DBE, DVBE, MBE, WBE, OBE, SDB, WoSB, HUBZone, and SDVOSB Subcontractors for which the Bidders are seeking recognition towards achieving any mandatory, voluntary, or both subcontracting participation percentages.

NAME, ADDRESS AND TELEPHONE NUMBER OF SUBCONTRACTOR	CONSTRUCTOR OR DESIGNER	SUBCONTRACTOR LICENSE NUMBER	TYPE OF WORK	DOLLAR VALUE OF SUBCONTRACT	MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB①	WHERE CERTIFIED②	CHECK IF JOINT VENTURE PARTNERSHIP
Name:_____ Address:_____ City:_____ State:_____ Zip:_____ Phone:_____ Email:_____							
Name:_____ Address:_____ City:_____ State:_____ Zip:_____ Phone:_____ Email:_____							

① As appropriate, Bidder shall identify Subcontractor as one of the following and shall include a valid proof of certification (except for OBE, SLBE and ELBE):

Certified Minority Business Enterprise	MBE	Certified Woman Business Enterprise	WBE
Certified Disadvantaged Business Enterprise	DBE	Certified Disabled Veteran Business Enterprise	DVBE
Other Business Enterprise	OBE	Certified Emerging Local Business Enterprise	ELBE
Certified Small Local Business Enterprise	SLBE	Small Disadvantaged Business	SDB
Woman-Owned Small Business	WoSB	HUBZone Business	HUBZone
Service-Disabled Veteran Owned Small Business	SDVOSB		

② As appropriate, Bidder shall indicate if Subcontractor is certified by:

City of San Diego	CITY	State of California Department of Transportation	CALTRANS
California Public Utilities Commission	CPUC		
State of California's Department of General Services	CADoGS	City of Los Angeles	LA
State of California	CA	U.S. Small Business Administration	SBA

The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.

NAMED EQUIPMENT/MATERIAL SUPPLIER LIST

***** PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY *** TO BE SUBMITTED IN ELECTRONIC FORMAT ONLY *** SEE INSTRUCTIONS TO BIDDERS FOR FURTHER INFORMATION**

NAME, ADDRESS AND TELEPHONE NUMBER OF VENDOR/SUPPLIER	MATERIALS OR SUPPLIES	DOLLAR VALUE OF MATERIAL OR SUPPLIES	SUPPLIER (Yes/No)	MANUFACTURER (Yes/No)	MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB①	WHERE CERTIFIED②
Name:_____ Address:_____ City:_____ State:_____ Zip:_____ Phone:_____ Email:_____						
Name:_____ Address:_____ City:_____ State:_____ Zip:_____ Phone:_____ Email:_____						

① As appropriate, Bidder shall identify Vendor/Supplier as one of the following and shall include a valid proof of certification (except for OBE, SLBE and ELBE):

Certified Minority Business Enterprise	MBE	Certified Woman Business Enterprise	WBE
Certified Disadvantaged Business Enterprise	DBE	Certified Disabled Veteran Business Enterprise	DVBE
Other Business Enterprise	OBE	Certified Emerging Local Business Enterprise	ELBE
Certified Small Local Business Enterprise	SLBE	Small Disadvantaged Business	SDB
Woman-Owned Small Business	WoSB	HUBZone Business	HUBZone
Service-Disabled Veteran Owned Small Business	SDVOSB		

② As appropriate, Bidder shall indicate if Vendor/Supplier is certified by:

City of San Diego	CITY	State of California Department of Transportation	CALTRANS
California Public Utilities Commission	CPUC		
State of California's Department of General Services	CADoGS	City of Los Angeles	LA
State of California	CA	U.S. Small Business Administration	SBA

The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.

ELECTRONICALLY SUBMITTED FORMS

FAILURE TO FULLY COMPLETE AND SUBMIT ANY OF THE FOLLOWING FORMS WILL DEEM YOUR BID NON-RESPONSIVE.

PLANETBIDS WILL NOT ALLOW FOR BID SUBMISSIONS WITHOUT THE ATTACHMENT OF THESE FORMS

The following forms are to be completed by the bidder and submitted (uploaded) electronically with the bid in PlanetBids.

A. **BID BOND – See Instructions to Bidders, Bidders Guarantee of Good Faith (Bid Security) for further instructions**

B. **CONTRACTOR'S CERTIFICATION OF PENDING ACTIONS**

C. **MANDATORY DISCLOSURE OF BUSINESS INTERESTS FORM**

D. **DEBARMENT AND SUSPENSION CERTIFICATION FOR PRIME CONTRACTOR**

E. **DEBARMENT AND SUSPENSION CERTIFICATION FOR SUBCONTRACTORS, SUPPLIERS AND MANUFACTURERS**

BID BOND

See Instructions to Bidders, Bidder Guarantee of Good Faith
(Bid Security)

KNOW ALL MEN BY THESE PRESENTS,

That SOUTHERN CONTRACTING COMPANY as Principal, and NATIONWIDE MUTUAL INSURANCE COMPANY as Surety, are held and firmly bound unto The City of San Diego hereinafter called "OWNER," in the sum of **10% OF THE TOTAL BID AMOUNT** for the payment of which sum, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, said Principal has submitted a Bid to said OWNER to perform the WORK required under the bidding schedule(s) of the OWNER's Contract Documents entitled

MBC GAS DETECTION SYSTEM REPLACEMENT; BID NO.: K-23-2127-DBB-3

NOW THEREFORE, if said Principal is awarded a contract by said OWNER and, within the time and in the manner required in the "Notice Inviting Bids" enters into a written Agreement on the form of agreement bound with said Contract Documents, furnishes the required certificates of insurance, and furnishes the required Performance Bond and Payment Bond, then this obligation shall be null and void, otherwise it shall remain in full force and effect. In the event suit is brought upon this bond by said OWNER and OWNER prevails, said Surety shall pay all costs incurred by said OWNER in such suit, including a reasonable attorney's fee to be fixed by the court.

SIGNED AND SEALED, this 24TH day of APRIL, 2023

SOUTHERN CONTRACTING COMPANY (SEAL)
(Principal)

By: _____
(Signature)
PHILIP E. WATERMAN, PRESIDENT

NATIONWIDE MUTUAL INSURANCE COMPANY (SEAL)
(Surety)

By: _____
(Signature)
MARK D. IATAROLA, ATTORNEY-IN-FACT

(SEAL AND NOTARIAL ACKNOWLEDGEMENT OF SURETY)

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT CIVIL CODE § 1189

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of SAN DIEGO

On 4/24/2023 *Date* before me, SANDRA FIGUEROA, NOTARY PUBLIC *Here Insert Name and Title of the Officer*,

personally appeared MARK D. IATAROLA *Name(s) of Signer(s)*,

who proved to me on the basis of satisfactory evidence to be the person~~(s)~~ whose name~~(s)~~ is/~~are~~ subscribed to the within instrument and acknowledged to me that he/~~she/they~~ executed the same in his/~~her/their~~ authorized capacity~~(ies)~~, and that by his/~~her/their~~ signature~~(s)~~ on the instrument the person~~(s)~~, or the entity upon behalf of which the person~~(s)~~ acted, executed the instrument.

SANDRA FIGUEROA
COMM. # 2334108
SAN DIEGO COUNTY
NOTARY PUBLIC-CALIFORNIA
MY COMMISSION EXPIRES
SEPTEMBER 22, 2024

Place Notary Seal and/or Stamp Above

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____ *Signature of Notary Public*

OPTIONAL

Completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document

Title or Type of Document: _____

Document Date: _____ Number of Pages: _____

Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: MARK D. IATAROLA	Signer's Name: _____
☐ Corporate Officer – Title(s): _____	☐ Corporate Officer – Title(s): _____
☐ Partner – ☐ Limited ☐ General	☐ Partner – ☐ Limited ☐ General
☐ Individual ☒ Attorney in Fact	☐ Individual ☐ Attorney in Fact
☐ Trustee ☐ Guardian of Conservator	☐ Trustee ☐ Guardian of Conservator
☐ Other: _____	☐ Other: _____
Signer is Representing: _____	Signer is Representing: _____

Power of Attorney

KNOW ALL MEN BY THESE PRESENTS THAT:

Nationwide Mutual Insurance Company, an Ohio corporation

hereinafter referred to severally as the "Company" and collectively as "the Companies" does hereby make, constitute and appoint:
HELEN MALONEY; JOHN G MALONEY; MARK D IATAROLA; SANDRA FIGUEROA; TRACY LYNN RODRIGUEZ;

each in their individual capacity, its true and lawful attorney-in-fact, with full power and authority to sign, seal, and execute on its behalf any and all bonds and undertakings, and other obligatory instruments of similar nature, in penalties not exceeding the sum of

UNLIMITED

and to bind the Company thereby, as fully and to the same extent as if such instruments were signed by the duly authorized officers of the Company; and all acts of said Attorney pursuant to the authority given are hereby ratified and confirmed.

This power of attorney is made and executed pursuant to and by authority of the following resolution duly adopted by the board of directors of the Company:

"RESOLVED, that the president, or any vice president be, and each hereby is, authorized and empowered to appoint attorneys-in-fact of the Company, and to authorize them to execute and deliver on behalf of the Company any and all bonds, forms, applications, memorandums, undertakings, recognizances, transfers, contracts of indemnity, policies, contracts guaranteeing the fidelity of persons holding positions of public or private trust, and other writings obligatory in nature that the business of the Company may require; and to modify or revoke, with or without cause, any such appointment or authority; provided, however, that the authority granted hereby shall in no way limit the authority of other duly authorized agents to sign and countersign any of said documents on behalf of the Company."

"RESOLVED FURTHER, that such attorneys-in-fact shall have full power and authority to execute and deliver any and all such documents and to bind the Company subject to the terms and limitations of the power of attorney issued to them, and to affix the seal of the Company thereto; provided, however, that said seal shall not be necessary for the validity of any such documents."

This power of attorney is signed and sealed under and by the following bylaws duly adopted by the board of directors of the Company.

Execution of Instruments. Any vice president, any assistant secretary or any assistant treasurer shall have the power and authority to sign or attest all approved documents, instruments, contracts, or other papers in connection with the operation of the business of the company in addition to the chairman of the board, the chief executive officer, president, treasurer or secretary; provided, however, the signature of any of them may be printed, engraved, or stamped on any approved document, contract, instrument, or other papers of the Company.

IN WITNESS WHEREOF, the Company has caused this instrument to be sealed and duly attested by the signature of its officer the 20th day of August, 2021.

Antonio C. Albanese, **Vice President** of Nationwide Mutual Insurance Company

ACKNOWLEDGMENT

STATE OF NEW YORK COUNTY OF NEW YORK: ss
On this 20th day of August, 2021, before me came the above-named officer for the Company aforesaid, to me personally known to be the officer described in and who executed the preceding instrument, and he acknowledged the execution of the same, and being by me duly sworn, deposes and says, that he is the officer of the Company aforesaid, that the seal affixed hereto is the corporate seal of said Company, and the said corporate seal and his signature were duly affixed and subscribed to said instrument by the authority and direction of said Company.

Stephanie Rubino McArthur
Notary Public, State of New York
No. 02MC6270117
Qualified in New York County
Commission Expires October 19, 2024

Notary Public
My Commission Expires
October 19, 2024

CERTIFICATE

I, Laura B. Guy, Assistant Secretary of the Company, do hereby certify that the foregoing is a full, true and correct copy of the original power of attorney issued by the Company; that the resolution included therein is a true and correct transcript from the minutes of the meetings of the boards of directors and the same has not been revoked or amended in any manner; that said Antonio C. Albanese was on the date of the execution of the foregoing power of attorney the duly elected officer of the Company, and the corporate seal and his signature as officer were duly affixed and subscribed to the said instrument by the authority of said board of directors; and the foregoing power of attorney is still in full force and effect.

IN WITNESS WHEREOF, I have hereunto subscribed my name as Assistant Secretary, and affixed the corporate seal of said Company this 24TH day of APRIL, 2023.

Assistant Secretary

BDJ 1(08-21)00

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT **CIVIL CODE § 1189**

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California)
County of San Diego)

On 04/24/2023 before me, Lynn R. Murison-Eroles, Notary Public,
Date *Here Insert Name and Title of the Officer*

personally appeared Philip E. Waterman
Name(s) of Signer(s)

,

who proved to me on the basis of satisfactory evidence to be the person~~(s)~~ whose name~~(s)~~ is~~/are~~ subscribed to the within instrument and acknowledged to me that he~~/she/they~~ executed the same in his~~/her/their~~ authorized capacity~~(ies)~~, and that by his~~/her/their~~ signature~~(s)~~ on the instrument the person~~(s)~~, or the entity upon behalf of which the person~~(s)~~ acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

LYNN R. MURISON-EROLES
Notary Public - California
San Diego County
Commission # 2329099
My Comm. Expires Jun 22, 2024

Signature Lynn R. Murison-Eroles
Signature of Notary Public

Place Notary Seal Above

OPTIONAL

Though this section is optional, completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document

Title or Type of Document: Bid Bond
Document Date: 04/24/2024 Number of Pages: 1
Signer(s) Other Than Named Above:

Capacity(ies) Claimed by Signer(s)

Signer's Name: Philip E. Waterman	Signer's Name:
☒ Corporate Officer — Title(s): President	☐ Corporate Officer — Title(s):
☐ Partner — ☐ Limited ☐ General	☐ Partner — ☐ Limited ☐ General
☐ Individual ☐ Attorney in Fact	☐ Individual ☐ Attorney in Fact
☐ Trustee ☐ Guardian or Conservator	☐ Trustee ☐ Guardian or Conservator
☐ Other:	☐ Other:
Signer Is Representing:	Signer Is Representing:

CONTRACTOR'S CERTIFICATION OF PENDING ACTIONS

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of all instances within the past 10 years where a complaint was filed or pending against the Bidder in a legal or administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers, and a description of the status or resolution of that complaint, including any remedial action taken.

CHECK ONE BOX ONLY.

☒ The undersigned certifies that within the past 10 years the Bidder has NOT been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers.

☐ The undersigned certifies that within the past 10 years the Bidder has been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers. A description of the status or resolution of that complaint, including any remedial action taken and the applicable dates is as follows:

DATE OF CLAIM	LOCATION	DESCRIPTION OF CLAIM	LITIGATION (Y/N)	STATUS	RESOLUTION/REMEDIAL ACTION TAKEN

Contractor Name: Southern Contracting Company

Certified By: Philip E. Waterman (Name) — Title: President

Signature — Date: 4/25/2023

USE ADDITIONAL FORMS AS NECESSARY

Mandatory Disclosure of Business Interests Form

BIDDER/PROPOSER INFORMATION

Legal Name		DBA	
Southern Contracting Company		Southern Contracting Company	
Street Address	**City**	**State**	**Zip**
559 N. Twin Oaks Valley Rd, San Marcos		California	92069
Contact Person, Title		**Phone**	**Fax**
Philip E. Waterman, President		(760) 744-0760	

Provide the name, identity, and precise nature of the interest* of all persons who are directly or indirectly involved** in this proposed transaction (SDMC § 21.0103).

* The precise nature of the interest includes:

- the percentage ownership interest in a party to the transaction,
- the percentage ownership interest in any firm, corporation, or partnership that will receive funds from the
- transaction, the value of any financial interest in the transaction,
- any contingent interest in the transaction and the value of such interest should the contingency be satisfied, and any
- philanthropic, scientific, artistic, or property interest in the transaction.

** Directly or indirectly involved means pursuing the transaction by:

- communicating or negotiating with City officers or employees,
- submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City,
- or directing or supervising the actions of persons engaged in the above activity.

Name	Title/Position
Timothy R. McBride	CEO
City and State of Residence	**Employer (if different than Bidder/Proposer)**
Escondido, CA	
Interest in the transaction	
90%	

Name	Title/Position
Richard W. McBride	COB
City and State of Residence	**Employer (if different than Bidder/Proposer)**
Escondido, CA	
Interest in the transaction	
10%	

*** Use Additional Pages if Necessary ***

Under penalty of perjury under the laws of the State of California, I certify that I am responsible for the completeness and accuracy of the responses contained herein, and that all information provided is true, full and complete to the best of my knowledge and belief. I agree to provide written notice to the Mayor or Designee within five (5) business days if, at any time, I learn that any portion of this Mandatory Disclosure of Business Interests Form requires an updated response. Failure to timely provide the Mayor or Designee with written notice is grounds for Contract termination.

Philip E. Waterman, President		4/25/2023
Print Name, Title	Signature	Date

Failure to sign and submit this form with the bid/proposal shall make the bid/proposal non-responsive. In the case of an informal solicitation, the contract will not be awarded unless a signed and completed Mandatory Disclosure of Business Interests Form is submitted.

DEBARMENT AND SUSPENSION CERTIFICATION

PRIME CONTRACTOR

FAILURE TO COMPLETE AND SUBMIT AT TIME OF BID SHALL RENDER BID NON-RESPONSIVE

EFFECT OF DEBARMENT OR SUSPENSION
To promote integrity in the City's contracting processes and to protect the public interest, the City shall only enter into contracts with responsible- bidders and contractors. In accordance with San Diego Municipal Code §22.0814 (a): *Bidders* and *contractors* who have been *debarred* or *suspended* are excluded from submitting bids, submitting responses to requests for proposal or qualifications, receiving *contract* awards, executing *contracts*, participating as a *subcontractor*, employee, agent or representative of another *person* contracting with the City.

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of Names of the Principal Individual owner(s).

The names of all persons interested in the foregoing proposal as Principals are as follows:

NAME	TITLE
Philip E. Waterman	President

IMPORTANT NOTICE: If Bidder or other interested person is a corporation, state secretary, treasurer, and manager thereof; if a co-partnership, state true name of firm, also names of all individual co-partners composing firm; if Bidder or other interested person is an individual, state first and last names in full.

The Bidder, under penalty of perjury, certifies that, except as noted below, he/she or any person associated therewith in the capacity of owner, partner, director, officer, manager:

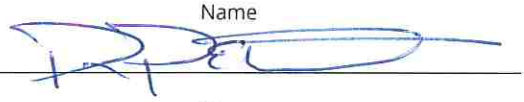
- Is not currently under suspension, debarment, voluntary exclusion, or determination of ineligibility by any Federal, State or local agency;
- has not been suspended, debarred, voluntarily excluded or determined ineligible by any Federal, State or local agency within the past 3 years;
- does not have a proposed debarment pending; and
- has not been indicted, convicted, or had a civil judgment rendered against it by a court of competent jurisdiction in any matter involving fraud or official misconduct within the past 3 years.

If there are any exceptions to this certification, insert the exceptions in the following space.

Exceptions will be considered in determining bidder responsibility. For any exception noted above, indicate below to whom it applies, initiating agency, and dates of action.

Contractor Name: Southern Contracting Company

Certified By: Philip E. Waterman (Name) — Title: President



Signature — Date: 4/25/2023

NOTE: Providing false information may result in criminal prosecution or administrative sanctions.

DEBARMENT AND SUSPENSION CERTIFICATION

SUBCONTRACTORS, SUPPLIERS AND MANUFACTURERS

TO BE COMPLETED BY BIDDER

FAILURE TO COMPLETE AND SUBMIT AT TIME OF BID SHALL RENDER BID NON-RESPONSIVE

Names of the Principal individual owner(s)

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of Names of the Principal Individual owner(s) for their subcontractor/supplier/manufacturers.

Please indicate if principal owner is serving in the capacity of **subcontractor**, **supplier,** and/or **manufacturer**:

☒ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE
Brian Jennette	President

☐ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE

☐ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE

☐ SUBCONTRACTOR ☐ SUPPLIER ☐ MANUFACTURER

NAME	TITLE

Contractor Name: Jennette Company, Inc.

Certified By Brian Jennette Title President

Name

Brian Jennette Date 4/25/23

Signature

USE ADDITIONAL FORMS AS NECESSARY*

Bid Results

Bidder Details

Vendor Name	Southern Contracting Company
Address	559 North Twin Oaks Valley Road San Marcos, California 92069 United States
Respondee	Philip Waterman
Respondee Title	President
Phone	760-744-0760
Email	pwaterman@southerncontracting.com
Vendor Type	PQUAL, CADIR
License #	222252
CADIR	1000002172

Bid Detail

Bid Format	Electronic
Submitted	04/25/2023 1:32 PM (PDT)
Delivery Method	
Bid Responsive	
Bid Status	Submitted
Confirmation #	328482

Respondee Comment

Buyer Comment

Attachments

File Title	File Name	File Type
Subcontractor Debarment and Suspension Cert.pdf	Subcontractor Debarment and Suspension Cert.pdf	Debarment and Suspension Form - Subs/Supp/MFR
Debarment and Suspension Certification for Prime Contractor.pdf	Debarment and Suspension Certification for Prime Contractor.pdf	Debarment and Suspension Form - Prime
Mandatory Disclosure of Business Interests Form.pdf	Mandatory Disclosure of Business Interests Form.pdf	Mandatory Disclosure of Business Interests Form
Contractors Certification of Pending Actions.pdf	Contractors Certification of Pending Actions.pdf	Contractor's Certification of Pending Actions
Bid Bond.pdf	Bid Bond.pdf	Bid Bond

Subcontractors

Showing 1 Subcontractor

Name & Address	Desc	License Num	CADIR	Amount	Type
Jennette Company, Inc. 9235 Trade Place Suite B San Diego, California 92126	Constructor - Sample Tubing Installation & Concrete	1007413	1000042413	$265,135.00	ELBE, Local

Line Items

Discount Terms No Discount

Item #	Item Code	Type	Item Description	UOM	QTY	Unit Price	Line Total	Response	Comment
Main Bid							$3,907,010.00		
1	524126		Bonds (Payment and Performance)	LS	1	$30,000.00	$30,000.00	Yes	
2	236220		Building Permits (EOC Type I)	AL	1	$25,000.00	$25,000.00	Yes	
3	238210		Mobilization	LS	1	$114,000.00	$114,000.00	Yes	
4			Field Orders (EOC Type II)	AL	1	$450,000.00	$450,000.00	Yes	
5	237310		Minor WPCP Development and Implementation	LS	1	$10,000.00	$10,000.00	Yes	
6	541320		Irrigation Repair	LS	1	$1,000.00	$1,000.00	Yes	
7	238210		Removal of Existing Gas Sensors and Conductors	EA	204	$931.50	$190,026.00	Yes	
8	238210		Demolition - Area 51	LS	1	$65,000.00	$65,000.00	Yes	
9	238210		Demolition - Area 60	LS	1	$20,000.00	$20,000.00	Yes	
10	238210		Demolition - Area 70	LS	1	$16,000.00	$16,000.00	Yes	
11	238210		Demolition - Area 73	LS	1	$5,000.00	$5,000.00	Yes	
12	238210		Demolition - Area 76	LS	1	$49,000.00	$49,000.00	Yes	
13	238210		Demolition - Area 80	LS	1	$15,000.00	$15,000.00	Yes	
14	238210		Demolition - Area 86	LS	1	$54,000.00	$54,000.00	Yes	
15	238210		Demolition - Area 94	LS	1	$10,000.00	$10,000.00	Yes	
16	238210		Electrical Raceways, Boxes, and Conductors - Area 51	LS	1	$110,000.00	$110,000.00	Yes	
17	238210		Electrical Raceways, Boxes, and Conductors - Area 60	LS	1	$25,000.00	$25,000.00	Yes	
18	238210		Electrical Raceways, Boxes, and Conductors - Area 70	LS	1	$15,000.00	$15,000.00	Yes	
19	238210		Electrical Raceways, Boxes, and Conductors - Area 73	LS	1	$30,000.00	$30,000.00	Yes	
20	238210		Electrical Raceways, Boxes, and Conductors - Area 76	LS	1	$185,000.00	$185,000.00	Yes	
21	238210		Electrical Raceways, Boxes, and Conductors - Area 80	LS	1	$105,000.00	$105,000.00	Yes	
22	238210		Electrical Raceways, Boxes, and Conductors - Area 86	LS	1	$275,000.00	$275,000.00	Yes	
23	238210		Electrical Raceways, Boxes, and Conductors - Area 94	LS	1	$10,000.00	$10,000.00	Yes	
24	238210		Electrical Raceways, Boxes, and Conductors - Area 19	LS	1	$15,000.00	$15,000.00	Yes	
25	238210		Point Type Gas Sensor	EA	16	$7,812.50	$125,000.00	Yes	
26	238210		Single Point Sample Type Gas Sensor System, One Sensor	EA	41	$24,024.00	$984,984.00	Yes	
27	238210		Single Point Sample Type Gas Sensor System, Two Sensor	EA	4	$40,000.00	$160,000.00	Yes	
28	238210		Open Path Type Gas Sensor	EA	4	$33,750.00	$135,000.00	Yes	
29	238210		Instrumentation and Controls - Area 51	LS	1	$61,000.00	$61,000.00	Yes	
30	238210		Instrumentation and Controls - Area 60	LS	1	$55,000.00	$55,000.00	Yes	
31	238210		Instrumentation and Controls - Area 70	LS	1	$59,000.00	$59,000.00	Yes	
32	238210		Instrumentation and Controls - Area 73	LS	1	$1,000.00	$1,000.00	Yes	
33	238210		Instrumentation and Controls - Area 76	LS	1	$125,000.00	$125,000.00	Yes	
34	238210		Instrumentation and Controls - Area 80	LS	1	$66,000.00	$66,000.00	Yes	
35	238210		Instrumentation and Controls - Area 86	LS	1	$133,000.00	$133,000.00	Yes	
36	238210		Instrumentation and Controls - Area 94	LS	1	$60,000.00	$60,000.00	Yes	
37	238210		Instrumentation and Controls - Area 19	LS	1	$18,000.00	$18,000.00	Yes	
38	238210		Startup and Commissioning	LS	1	$100,000.00	$100,000.00	Yes	

Line Item Subtotals

Section Title	Line Total
Main Bid	**$3,907,010.00**
Grand Total	**$3,907,010.00**